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Tank Characterization Report for Single-Shell Tank 241-B-104

J. G. Field
Westinghouse Hanford Company, Richland, WA 99352
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Abstract: This document summarizes information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-B-104. Sampling and analyses meet safety screening and historical data quality objectives. This report supports the requirements of Tri-party Agreement Milestone M-44-09.

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Tank Characterization Report for Single-Shell Tank 241-B-104

J. G. Field
J. Jo
Westinghouse Hanford Company

T. T. Tran
Los Alamos Technical Associates, Inc.

Date Published
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Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Westinghouse Hanford Company
P.O Box 1970
Richland, Washington

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EXECUTIVE SUMMARY

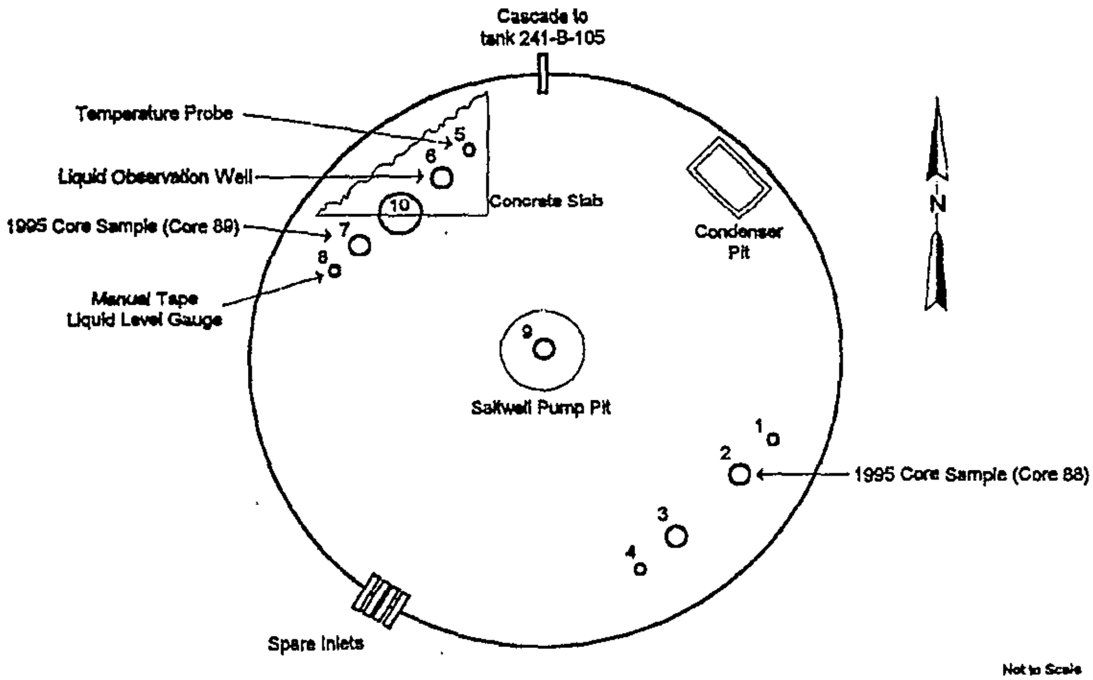
This characterization report summarizes the available information on the historical uses and the current status of single-shell tank 241-B-104, and presents the analytical results of the June 1995 sampling and analysis effort. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* Milestone M-44-09 (Ecology et al. 1994).

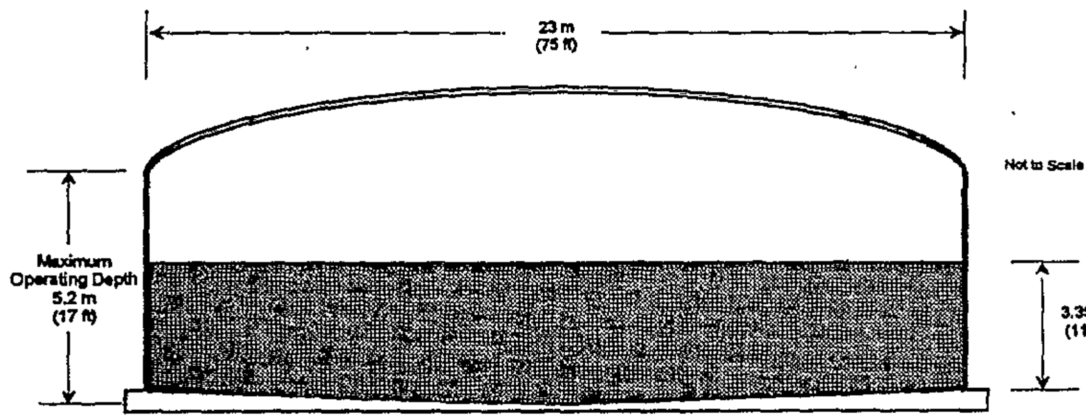
Tank 241-B-104 is a single-shell underground waste storage tank located in the 200 East Area B Tank Farm on the Hanford Site. It is the first tank in a three-tank cascade series. The tank went into service in August 1946 with a transfer of second-cycle decontamination waste generated from the bismuth phosphate process. The tank continued to receive this waste type until the third quarter of 1950, when it began receiving first-cycle decontamination waste also produced during the bismuth phosphate process. Following this, the tank received evaporator bottoms sludge from the 242-B Evaporator and waste generated from the flushing of transfer lines. A description and the status of tank 241-B-104 are summarized in Table ES-1 and Figure ES-1. The tank has an operating capacity of 2,010 kL (530 kgal), and presently contains 1,400 kL (371 kgal) of waste. The total amount is composed of 4 kL (1 kgal) of supernatant, 260 kL (69 kgal) of saltcake, and 1,140 kL (301 kgal) of sludge (Hanlon 1995). Current surveillance data and observations appear to support these results.

Table ES-1. Description and Status of Tank 241-B-104.

TANK DESCRIPTION	
Type	Single-Shell
Constructed	1943-1944
In-service	1946
Diameter	23 m (75 ft)
Maximum operating depth	5.2 m (17 ft)
Capacity	2,010 kL (530 kgal)
Bottom Shape	Dish
Ventilation	Passive
TANK STATUS	
Total waste volume	1,400 kL (371 kgal)
Supernatant volume	4 kL (1 kgal)
Saltcake volume	260 kL (69 kgal)
Sludge volume	1,140 kL (301 kgal)
Drainable interstitial liquid volume	170 kL (46 kgal)
Waste surface level	3.35 m (11 ft)
Median temperature (1975 to present)	19 °C (66 °F)
Integrity	Sound
Watch List status	None
SAMPLING DATES	
Push-mode core samples	June 1-14, 1995
SERVICE STATUS	
Out of service	1978
Interim stabilized	1985
Intrusion prevention	1985

Figure ES-1. Profile of Tank 241-B-104.





Total Tank Volume: 2,010 kL (530 kgal)
Waste Volume (September 1995): 1,400 kL (371 kgal)
Supernate Volume (September 1995): 4 kL (1 kgal)
Sludge Volume (September 1995): 1,140 kL (301 kgal)
Saltcake Volume (September 1995): 260 kL (69 kgal)

This report summarizes the collection and analysis of a set of samples that were obtained in June 1995. The sampling event was performed to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) and *The Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994). Historical DQO requirements were not available at the time of sampling, but have since been applied to this tank (Simpson and McCain 1995). Additional information is needed to more fully comply with the Historical DQO.

The sampling effort consisted of the acquisition of two core samples of seven segments each by the push-mode core sampling method. Core 88 was taken from riser 2, and core 89 from riser 7. Hydrostatic head fluid was used in the sampling process.

The analytical results (Table ES-2) showed no violations of the safety screening data quality objective limits. The lowest weight percent water results (28.08 percent) came from the upper half of segment 4 core 88 (sample number S95T001068). The overall tank mean weight percent water was 46.9. The lower limit to a one-sided 95 percent confidence interval on the mean percent water was 34.02 percent. The highest detected total alpha activity (0.0838 μCi/g) came from the upper half of segment 3 core 88 (sample number S95T001064). The upper limit to a one-sided 95 percent confidence interval on the mean total alpha activity was 0.21 μCi/g, much less than the 41.0-μCi/g limit. No exothermic reactions were noted in the differential scanning calorimetric analyses (Jo 1995a), and the flammability in the tank headspace was measured at 0 percent of the lower flammability limit (LFL).

Table ES-2. Summary of Analytical Results and Projected Inventories.[1]

Analyte	Mean Concentration	RSD (Mean)	Projected Inventory[6]
Safety Screening Analytes			
Water content	46.9 weight percent (in the solids portion of the sample)	2.0 %	9.06E+05 kg[4]
	52.1 weight percent (in the drainable liquid portion of the sample)[3]	2.5 %	1.22E+05 kg[5]
Total alpha activity	0.0440 µCi/g	22.3 %	85 Ci
Fuel content	No exothermic reactions		
Opportunistic Analytes[2]			
Anions	µg/g	%	kg[4]
Chloride	2,110	4.2	4,080
Fluoride	3,460	20.6	6,680
Nitrate	2.90E+05	4.8	5.60E+05
Nitrite	2,450	8.7	4,730
Oxalate	< 1,470	n/a	< 2,840
Phosphate	23,300	3.8	45,000
Sulfate	21,400	9.1	41,300
ICP Analytical Results[1]			
Analyte	Overall Mean	RSD (Mean)	Projected Inventory
METALS	µg/g	%	kg
Al	1,843	39	3,560
Bi	11,425	24	22,050
Ca	328	31	630
Cr	513	33	990
Fe	10,794	13	20,830
P	17,043	15	32,890
Na	117,150	9	226,100
S	7,284	12	14,060
Si	5,697	20	11,000
U	<1,920	n/a	3,700

Notes:

RSD (Mean) = relative standard deviation of the mean
n/a = not applicable

[1]Jo (1995a)
[2]Analyses performed on opportunistic basis in accord with Kristofzski (1995); reported in Jo (1995a).
[3]Drainable liquid was only recovered in the top segment of Core 88, and 76% of the sample (by weight) was drainable liquid.
[4]Based on 1.38% g/mL density and 1,400 kL total waste volume.
[5]Based on 1.38% g/mL density and 170 kL drainable liquid.
[6]Projected inventory is based on density estimates from historical data. Historical data are not validated and errors introduced into the estimates are unknown.

Some results from the analysis of the tracer elements used in the hydrostatic head fluid were above the method detection limit, but all were below the action limit.

The heat load in the tank produced by radioactive decay is estimated at 0.0428 kW (146 Btu/hr) (Brevick et al. 1994a), which is less than the limit of 11.7 kW (39,000 Btu/hr), the boundary between high- and low-heat tanks (Bergmann 1991). Surveillance data show that, with the exception of one presumed erroneous spike, high temperatures since 1975 have remained below 32 °C (90 °F). Surface levels have remained within a range of 3.346 m (131.75 in.) to 3.35 m (132 in.) for the past three years.

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LIST OF TERMS

1C	first-cycle decontamination waste
2C	second-cycle decontamination waste
ANOVA	analysis of variance
B SLTCK	242-B Evaporator saltcake
Btu/hr	British thermal units per hour
C	Celsius
Ci	curies
Ci/L	curies per liter
DBP	dibutyl phosphate
DQO	data quality objective
DSC	differential scanning calorimetry
EDTA	ethylenediaminetetraacetic acid
F	Fahrenheit
ft	feet
g	grams
g/cc	grams per cubic centimeter
g/L	grams per liter
g/mL	grams per milliliter
gal	gallons
HDW	Hanford Defined Wastes
HEDTA	N-(hydroxylethyl)-ethylenediaminetriacetic acid
HHF	hydrostatic head fluid
HTCE	Hanford Tank Content Estimate
IC	ion chromatography
ICP/AES	inductively coupled plasma atomic emission spectrometry
in.	inches
J/g	joules per gram
kg	kilograms
kgal	kilogallons
kL	kiloliters
kW	kilowatts
L	liters
LFL	lower flammability limit
m	meters
mg	milligrams
mm	millimeters
mol/L	moles per liter
NTA	nitrilotriacetic acid
ppm	parts per million
QC	quality control
Rev.	Revision
RPD	relative percent difference

LIST OF TERMS (Continued)

RSD	relative standard deviation
TGA	thermogravimetric analysis
TLM	Tank Layer Model
WSTRS	Waste Status and Transaction Record Summary
μCi/g	microcuries per gram
μg/g	micrograms per gram
ΔH	change in enthalpy

1.0 INTRODUCTION

This characterization report presents an overview of single-shell tank 241-B-104 and its waste components. It provides estimated concentrations and inventories for the waste constituents based on the latest sampling and analysis activities and background tank information. Tank 241-B-104 was sampled in June 1995 to satisfy the requirements of *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) and *Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994).

Tank 241-B-104 was declared inactive in 1978. Interim stabilization and intrusion prevention have been completed in 1985; therefore, the composition of the waste should not change suddenly or unpredictably until pretreatment and retrieval activities commence. The analyte concentrations reported in this document reflect the best estimates of the waste composition based on the available analytical data and historical models. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* Milestone M-44-09 (Ecology et al. 1994).

1.1 PURPOSE

The purpose of this report is to summarize the information about the use and contents of tank 241-B-104. Where possible, this information will be used to assess issues associated with safety, operations, environmental, and process development activities. This report also serves as a reference point for more detailed information concerning tank 241-B-104.

1.2 SCOPE

The June 1995 core sampling event for tank 241-B-104 supported the evaluation of the tank waste according to the safety screening and pretreatment data quality objectives (DQOs). From the two core samples, four primary analyses were performed as directed in the *Tank 241-B-104 Tank Characterization Plan* (Jo 1995b). These analyses were differential scanning calorimetry (DSC) (to evaluate fuel level and energetics), thermogravimetric analysis (TGA) (to determine moisture content), total alpha activity (to evaluate criticality potential), and flammable gas concentration. Lithium was analyzed using inductively coupled plasma atomic emission spectrometry (ICP/AES) to check for sample contamination by the hydrostatic head fluid used during the push-mode core sampling process. Bromide was also analyzed as a secondary check for hydrostatic head fluid infiltration. In addition, anion and metals concentrations were measured using ion chromatography (IC) and ICP/AES in an opportunistic venture according to Kristofzski (1995). The number of analyses was limited due to the narrow focus of the sampling event: verification of the non-Watch List status of the tank and/or identification of any unknown safety issues associated with the tank.

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2.0 HISTORICAL TANK INFORMATION

This section describes tank 241-B-104 based on historical information. The first part of the section details the current condition of the tank, followed by discussions of the tank's background, transfer history, and process sources that contributed to the tank waste, including an estimate of the current contents based on the process history. Events that may be related to tank safety issues such as potentially hazardous tank contents (ferrocyanide, organics) or off-normal operating temperatures (tank damage, chemical reactions) are included. The final part of the section details any surveillance data available for the tank. Solid and liquid level data are used to determine tank integrity (leaks) and to provide clues to internal activity in the solid/crust layers of the tank (i.e., slurry growth from gas evolution with subsequent venting and collapse, or shrinkage due to drying). Drywell activity monitoring is noted where anomalies may suggest leaking of nearby tanks. Temperature data are provided to evaluate the heat-generating characteristics of the waste.

2.1 TANK STATUS

As of October 31, 1995, tank 241-B-104 contained 1,400 kL (371 kgal) of waste classified as non-complexed (Hanlon 1995). The amounts of various waste phases existing in the tank are presented in Table 2-1.

Table 2-1. Summary of Tank Contents.[1]

Waste Form	Volume	
	kL	kgal
Total waste	1,400	(371)
Supernatant liquid	4	(1)
Drainable interstitial liquid	170	(46)
Drainable liquid remaining	180	(47)
Pumpable liquid remaining	150	(40)
Sludge	1,140	(301)
Saltcake	260	(69)

Note:

[1]Hanlon (1995). Volume estimates are based on unvalidated historical data and should not be used to make decisions.

Tank 241-B-104 is identified as a sound tank that has been interim stabilized with intrusion prevention completed in 1985. Tank 241-B-104 is not on any Watch List. All monitoring systems described in Section 2.4 were in compliance with documented standards as of October 31, 1995 (Hanlon 1995).

2.2 TANK DESIGN AND BACKGROUND

The B Tank Farm was built between 1943-44, and consists of twelve 2,010-kL (530-kgal) tanks and four 210-kL (55-kgal) tanks. These tanks were designed for non-boiling waste with a maximum fluid temperature of 104 °C (220 °F). Equipment to monitor and maintain the waste is sparse. A typical B Farm tank contains 11 to 13 risers ranging in size from 50 mm (2 in.) to 1.1 m (42 in.) in diameter that provide surface-level access to the underground tank. Generally, there is one riser through the center of the tank dome, five each on opposite sides of the tank, and the remaining risers are scattered on the dome (Alstad 1993).

Tank 241-B-104 entered service in August 1946 and is first in a three-tank cascading series. The single-shell tank was constructed of 300-mm (1-ft)-thick reinforced concrete with a 6.4-mm (0.25-in.) mild carbon steel liner (ASTM A283 Grade C) on the bottom and sides and a 380-mm (1.25-ft)-thick domed concrete top. These tanks have dished bottoms with 1.2-m (4-ft) radius knuckles and 5.2-m (17-ft) operating depths. Tank 241-B-104's bottom center elevation is 187.5 m (615 ft) above mean sea level, cascading to tank 241-B-105 at 187.15 m (614 ft), which then cascades to tank 241-B-106 at 186.85 m (613 ft). The cascade overflow height is approximately 4.78 m (188 in.) from the tank bottom and 600 mm (2 ft) below the top of the steel liner. The tanks are set on a reinforced concrete foundation. Three-ply cotton fabric waterproofing was applied over the foundation and steel tank. Four coats of primer paint were sprayed on all exposed interior tank surfaces. Tank ceiling domes were covered with three applications of magnesium zincfluorosilicate wash. Lead flashing protects the joint where the steel liner meets the concrete dome, and asbestos gaskets seal the manholes in the tank dome. The tanks were waterproofed on the sides and top with tar and gunite. Each tank was covered with approximately 2.2 m (7.25 ft) of overburden.

The surface level is monitored through riser 8 with a manual tape. The thermocouple tree is in riser 5. Riser 10 is actually a manhole. Another manhole is located between risers 2 and 3 but is not called a riser. This tank has a liquid observation well located in riser 6. A plan view that depicts the riser configuration is shown as Figure 2-1. A list of tank 241-B-104 risers, showing the size and general use, is provided in Table 2-2. This constitutes all installed equipment for tank 241-B-104. The tank is passively ventilated (Anderson 1990).

A tank cross-section showing the approximate waste level along with a schematic of the tank equipment is found in Figure 2-2. Tank 241-B-104 has ten risers with risers 2 and 3 (each 300 mm [12 in.] in diameter) available for use.

Four tank inlets are available with one cascade overflow outlet located 4.9 m (191.5 in.) from the tank bottom (as measured at the tank wall). Figure 2-1 shows inlet locations.

Figure 2-1. Riser Configuration for Tank 241-B-104.

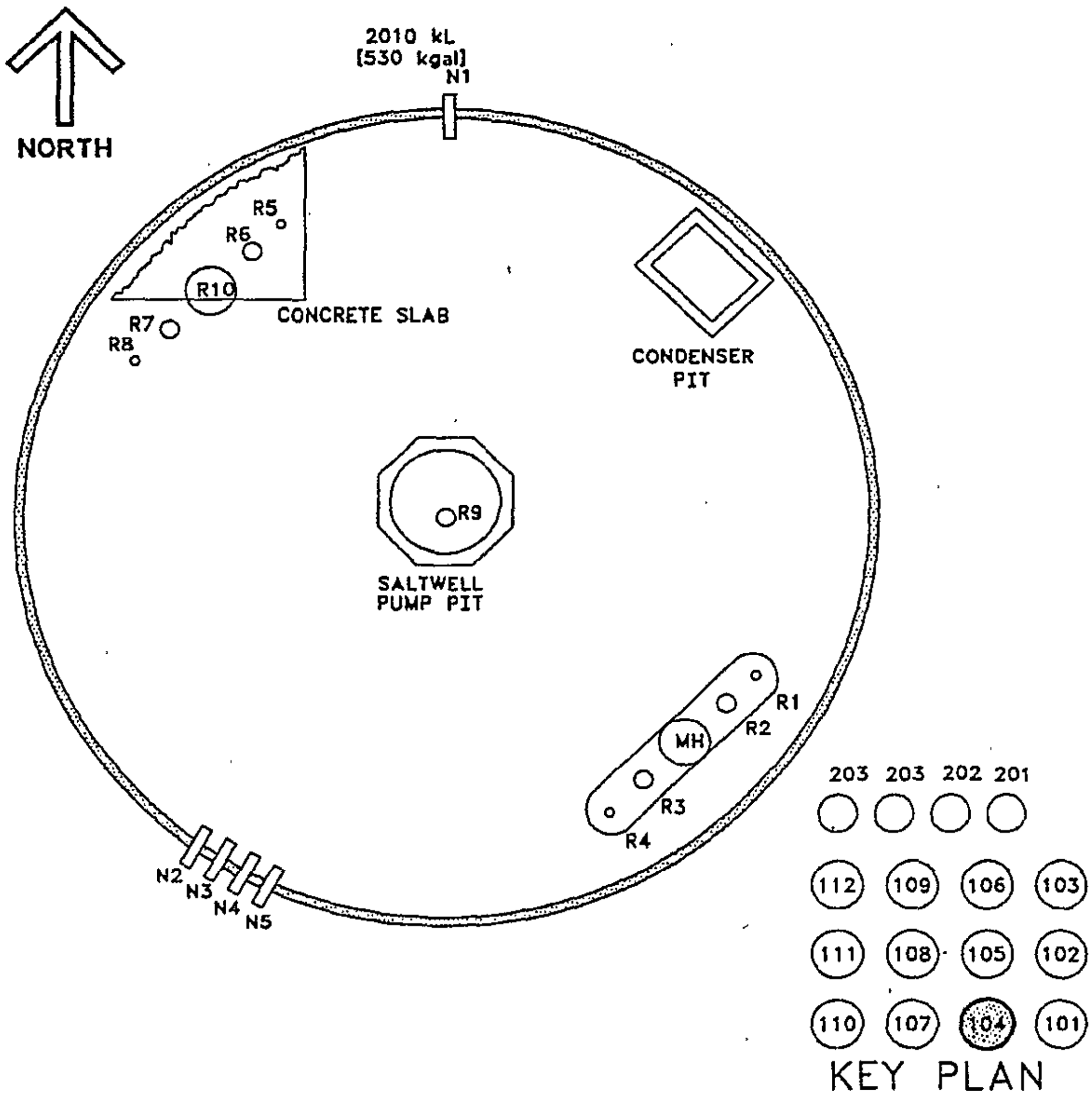
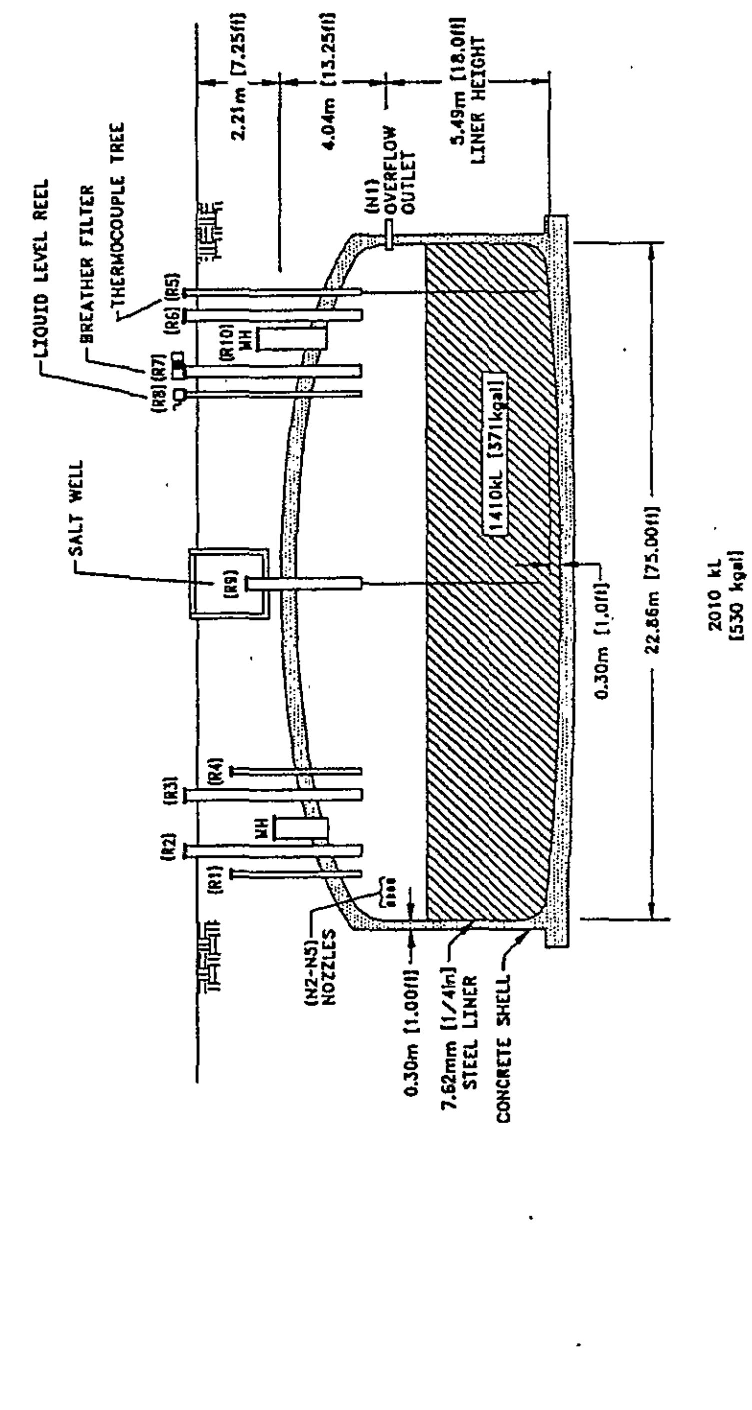


Table 2-2. Tank 241-B-104 Risers.[1]

Riser Number	Diameter (inches)	Description and Comments
R1	4	Below grade
R2	12	Flange with bale, benchmark (spare)
R3	12	Flange (spare)
R4	4	Below grade
R5	4	Thermocouple tree, benchmark
R6	12	B-436 liquid observation well
R7	12	Breather filter, G1 housing observation port
R8	4	Liquid level reel
R9	12	Saltwell screen and pump (weather covered)
R10	42	Manhole (below grade)
Nozzle Number	**Diameter (inches)**	**Description and Comments**
N1	3	Outlet nozzle
N2	3	Nozzle
N3	3	Nozzle
N4	3	Nozzle
N5	3	Nozzle

Note:
[1]Alstad (1993); Brevick et al. (1994b)

Figure 2-2. Tank 241-B-104 Configuration.



2.3 PROCESS KNOWLEDGE

These sections present the transfer history of tank 241-B-104 and describe the process wastes that made up these transfers. This is followed by an estimate of current tank contents based on transfer history.

2.3.1 Waste Transfer History

Tank 241-B-104 initially received waste in August of 1946 with a transfer from B Plant of second-cycle decontamination (2C) waste generated from the $BiPO_4$ process (Agnew et al. 1995b). The addition of 2C waste continued until the second quarter of 1950. In February 1947, the tank was declared full. From the first quarter of 1947 until the third quarter of 1950, the waste cascaded from tank 241-B-104 to tank 241-B-105. Supernatant liquid was pumped from tank 241-B-104 to Crib B-008 during the third quarter of 1948.

During the third quarter of 1950, tank 241-B-104 received first-cycle decontamination (1C) waste from an unknown source generated from the $BiPO_4$ process in B Plant (Agnew et al. 1995b). During the third quarter of 1952 and 1953, supernatant liquid was transferred from tank 241-B-104 to tank 241-B-106. Tank 241-B-104 received 242-B Evaporator bottoms intermittently from the fourth quarter of 1952 until the fourth quarter of 1955. During the third quarter of 1954 and the second quarter of 1959, tank 241-B-104 received water from an unknown source.

During the second quarter of 1969, supernatant liquid from tank 241-B-104 was transferred to tank 241-B-103. Tank 241-B-104 received flushing water waste from transfer lines in the second quarter of 1972. Also, supernatant liquid was pumped to tank 241-B-102 from tank 241-B-104 during the second quarter of 1972. Tank 241-B-104 was declared inactive in 1978 (Agnew et al. 1995b).

Table 2-3. Summary of Tank 241-B-104 Waste Input History.[1]

Transfer Source	Waste Type Received	Time Period	Waste Volume kL	(kgal)
B Plant	2nd cycle decontamination waste	1946 - 1950	10,876	(2,873)
B Plant	1st cycle decontamination waste	1950	1,840	(486)
241-B-106	242-B Evaporator saltcake waste	1952 - 1955	2,309	(610)
Transfer lines	Line flush water waste	1972	23	(6)

Note:
[1]Agnew et al. (1995b)

2.3.2 Historical Estimation of Tank Contents

The following is an estimate of the contents for tank 241-B-104 based on historical transfer data. The historical data used for the estimate are from the Waste Status and Transaction Record Summary (WSTRS) (Agnew et al. 1995b), the Hanford Defined Wastes (HDW) (Agnew 1995) list, and the Tank Layer Model (TLM) (Agnew et al. 1995a) from the Historical Tank Content Estimate (HTCE) (Brevick et al. 1994a) reports. WSTRS is a compilation of available waste transfer and volume status data. The HDW provides the assumed typical compositions for 50 separate waste types. In some cases, the available data are incomplete, thus reducing the usability of the transfer data and the modeling results derived from them. The TLM uses the WSTRS data to model the waste deposition processes. Using additional data from the HDW the TLM generates an estimate of the tank contents, which may introduce additional errors. Thus, these model predictions can only be considered as estimates that require further evaluation using analytical data and surveillance observations.

Based on the HTCE and the TLM, tank 241-B-104 contains 4 kL (1 kgal) of supernatant liquid, 230 kL (61 kgal) of 242-B Evaporator saltcake, 340 kL (90 kgal) of unknown waste, 458 kL (121 kgal) of first-cycle decontamination (1C) waste and 370 kL (98 kgal) of second-cycle decontamination (2C) waste. Figure 2-3 shows a graph representing the estimated waste types and volumes for the tank layers. The bottom layer is 2C waste and the layer above is 1C. The 2C (bottom) layer should contain large amounts of bismuth, sodium, phosphate, nitrate, iron, and water. Cesium and strontium should be relatively absent;

therefore, the activity should be very low. The 1C layer is similar to the 2C layer except that 1C contains aluminum and a larger amount of cesium. The greater quantity of cesium in the 1C layer will mean greater activity when compared to the 2C layer.

The next waste layer (located directly above the 1C layer) is of an unknown composition, and the constituents presently cannot be determined. From Agnew et al. (1995b) it appears that the unknown waste was accumulated during the addition of 2C waste in 1948 to 1949 followed by evaporator bottoms waste from 1953 to 1976. Therefore, comparisons with the other waste layers cannot be accomplished at this time. The 242-B Evaporator saltcake (B SLTCK) layer (above the unknown waste layer) should be mostly soluble and contain large amounts of sodium, nitrate, sulfate, phosphate, and aluminum. Cesium and strontium will be present, so the activity should be higher than the 1C or 2C layers. The B SLTCK is distinguished from 1C and 2C decontamination waste types by the presence of chlorine in the form of sodium chloride and a great quantity of sodium. The lowest weight percentage of water of the three waste types is evident in B SLTCK. Table 2-4 shows an estimate of the expected waste constituents and their concentrations.

Figure 2-3. Tank Layer Model.

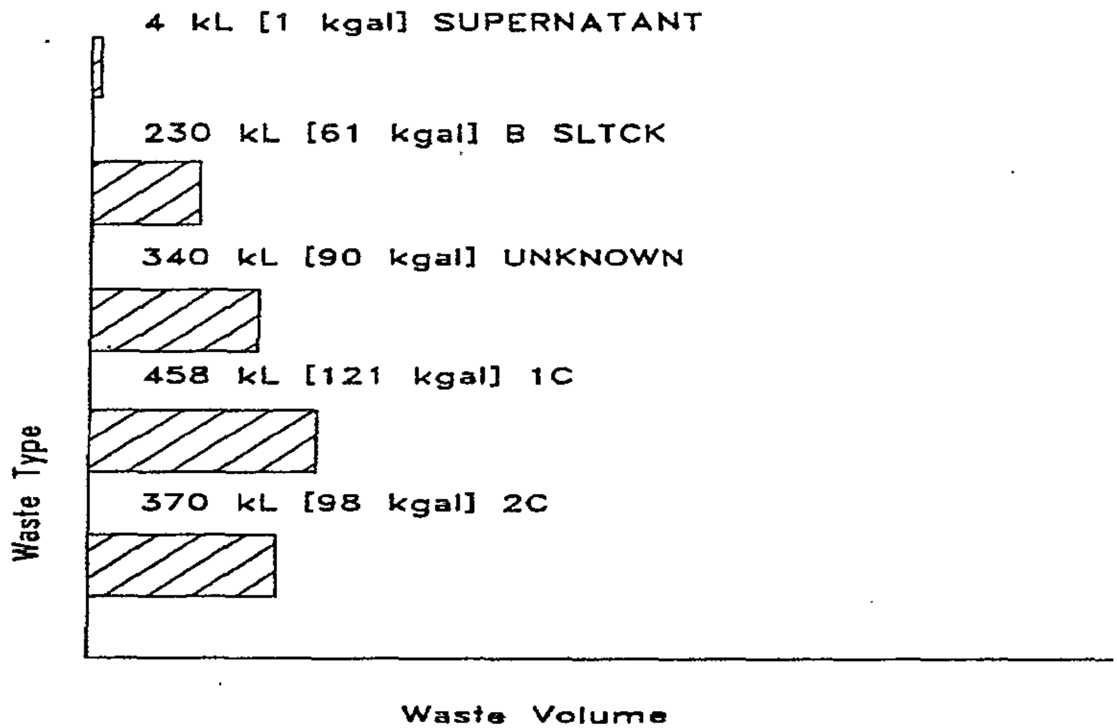


Table 2-4. Historical Tank 241-B-104 Inventory Estimate.[1] (2 sheets)

Solids Composite Inventory Estimate			
Physical Properties			
Total solid waste	1.47E+06 kg (280 kgal)		
Heat load	0.0428 kW (146 Btu/hr)		
Bulk density	1.38 (g/cc)		
Void fraction	0.661		
Water weight percent	65.4		
Total Organic Carbon weight percent Carbon (wet)	0		
Chemical Constituents	**mol/L**	**ppm**	**kg**
Na^{+}	6.28	1.04E+05	1.53E+05
Al^{3+}	0.610	11,900	17,500
Fe^{3+} (total Fe)	0.540	21,800	32,000
Cr^{3+}	0.00791	297	436
Bi^{3+}	0.0857	12,900	19,000
La^{3+}	0	0	0
Ce^{3+}	0	0	0
Zr (as $ZrO(OH)_2$)	0.00713	470	689
Pb^{2+}	0	0	0
Ni^{2+}	0.0240	1,020	1,490
Sr^{2+}	0	0	0
Mn^{4+}	0	0	0
Ca^{2+}	0.0788	2,280	3,350
K^{+}	0	0	0
OH^{-}	3.58	44,000	64,500
NO_3^{-}	1.17	52,300	76,700
NO_2^{-}	0.0918	3,050	4,470

Table 2-4. Historical Tank 241-B-104 Inventory Estimate.[1] (2 sheets)

Chemical Constituents (Cont'd)	mol/L	ppm	kg
CO_3^{2-}	0.0964	4,180	6,130
PO_4^{3-}	1.32	90,900	1.33E+05
SO_4^{2-}	0.169	11,700	17,200
Si (as SiO_3^{2-})	0.178	3,610	5,290
F^-	0.526	7,220	10,600
Cl^-	0.0268	687	1,010
$C_6H_5O_7^{3-}$	0	0	0
$EDTA^{4-}$	0	0	0
$HEDTA^{3-}$	0	0	0
NTA^{3-}	0	0	0
glycolate$^-$	0	0	0
acetate$^-$	0	0	0
oxalate^{2-}	0	0	0
DBP	0	0	0
NPH	0	0	0
CCl_4	0	0	0
hexone	0	0	0
$Fe(CN)_6^{4-}$	0	0	0
Radiological Constituents	**Ci/L**	**μCi/g**	**kg**
Pu		0.00661	0.162
U	7.15E-04 (mol/L)	123 (μg/g)	180
Cs	0.00756	5.47	8,010 (Ci)
Sr	7.43E-04	0.537	788 (Ci)

Note:

[1]Agnew et al. (1995a). This historical data has not been validated, and should not be used to make decisions.

2.4 SURVEILLANCE DATA

Tank 241-B-104 surveillance consists of surface level measurements (liquid and solid), temperature monitoring inside the tank (waste and headspace), and leak detection well (drywell) monitoring for radioactivity outside the tank. The surveillance data provide the basis for determining tank integrity.

Liquid level measurements are used to determine if there may be a major leak from the tank. Solid surface level measurements provide an indication of physical changes and consistency of the solid layers of a tank. Drywells located around the perimeter of the tank may detect increased radioactivity if there is a leak to the soil.

2.4.1 Surface Level Readings

The tank 241-B-104 surface level is monitored quarterly with a manual tape through riser 8. The maximum allowable increase from the 3.35 m (132 in.) baseline is 50 mm (2 in.) (Brevick et al. 1994b). The criterion for a decrease does not apply to this tank because the liquid level is below the waste surface. The surface level has remained relatively steady for the past three years (3.3 m [134 in.]). A level history graph representing the volume measurements is shown in Figure 2-4.

Tank 241-B-104 has a liquid observation well located below riser 6. The interstitial liquid level is monitored weekly with a neutron probe. On request, it can be monitored with a gamma probe. The maximum allowable deviations from the established baseline for interstitial liquid, as measured in the liquid observation well, are a 91-mm (3.58-in.) decrease or a 120-mm (4.72 in.) increase. Sketch ES-TKS-E14 in the supporting document for the HTCE has a graphical representation of the liquid observation well data. Two drywells are identified for tank 241-B-104.

2.4.2 Internal Tank Temperatures

Tank 241-B-104 has a single thermocouple tree with 12 thermocouples to monitor the waste temperature through riser 5. Elevations are not available for the thermocouples.

No temperature data are available prior to 1975. Thermocouples 1 through 11 have similar temperature data for the years 1975 to 1993. This suggests that there was no thermal gradient or radionuclide gradient in the tank during that time. Only three data points from 1974 to 1979 are available for thermocouple 12. Plots of the individual thermocouple readings can be found in the B Tank Farm supporting document (Brevick et al. 1994b).

The mean temperature of the first recorded data for thermocouples 1 through 11 was 17 °C (63 °F). From April 1975 to the present, the median temperature was 19 °C (66 °F), the minimum temperature was 11 °C (52 °F), and the maximum temperature (recorded in 1989) was 50 °C (122 °F). No data were available between 1983 and 1989. The 1989 temperature spike (shown in Figure 2-5) has not been verified and is most likely an error in the equipment or record. Tank 241-B-104 is a low-heat load tank and has a semiannual temperature monitoring requirement. It is monitored in January and July. A graphical representation of the weekly high temperature can be found in Figure 2-5.

2.4.3 Tank 241-B-104 Photographs

The tank 241-B-104 interior photographs taken in October 1988 (Brevick et al. 1994b) indicate a thin, bright yellow liquid covering part of the surface of a salt-like material. The tank contains about 1,400 kL (371 kgal) of waste that fills the tank to a depth of 3.35 m (almost 11 ft). Debris shown in the photographs includes sludge measurement weights, old sample bottles, and some level measurement tapes.

Figure 2-4. Tank Level History.

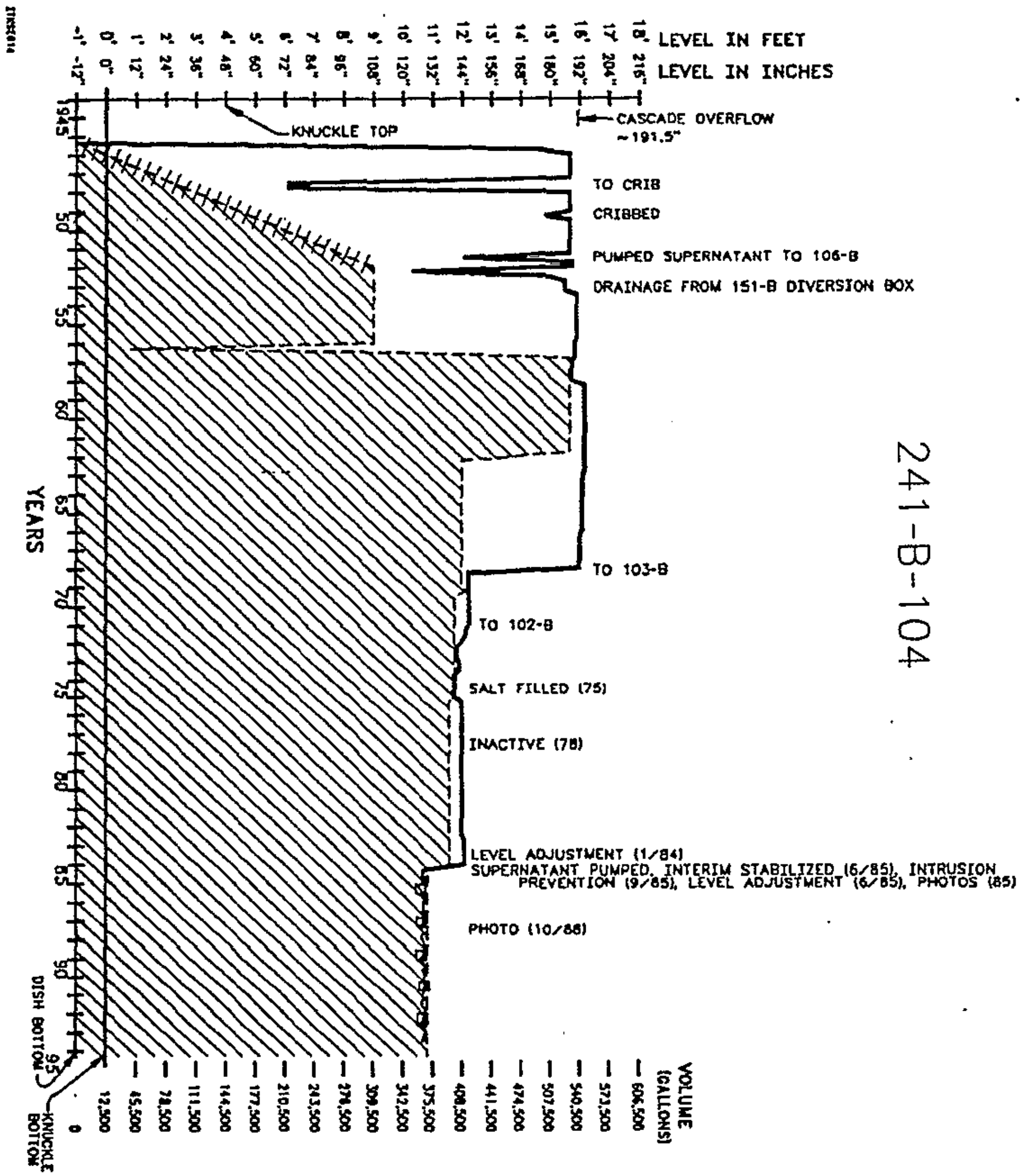
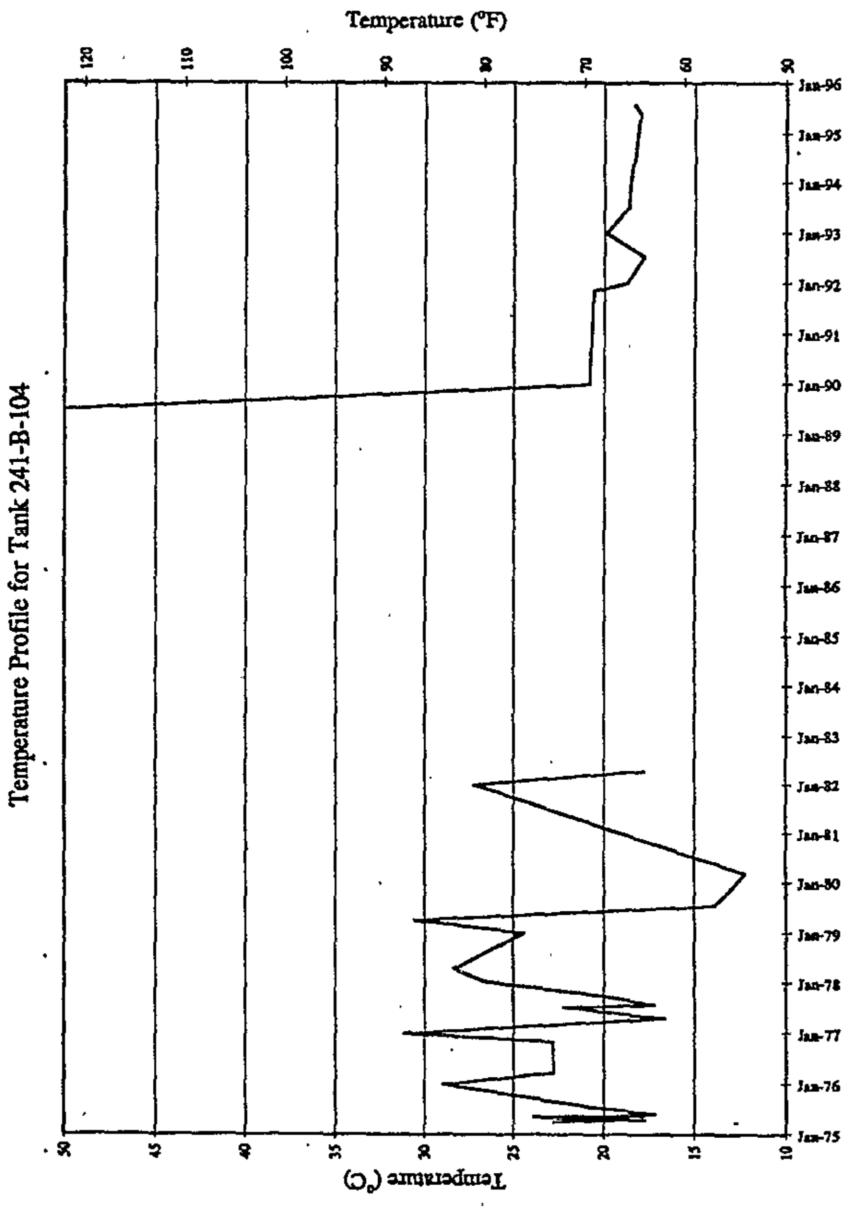


Figure 2-5. Tank 241-B-104 Weekly High Temperature Plot.



3.0 TANK SAMPLING OVERVIEW

This section describes the June 1995 sampling and analysis event for tank 241-B-104. Push-mode core samples were taken to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), and the *Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994). The sampling and analyses were performed in accordance with the *Tank 241-B-104 Tank Characterization Plan* (Jo 1995b). Further discussions of the sampling and analysis procedures can be found in the *Tank Characterization Reference Guide* (DeLorenzo et al. 1994).

3.1 DESCRIPTION OF SAMPLING EVENT

Two push-mode core samples were collected from tank 241-B-104 between June 1 and June 14, 1995. Cores 88 and 89 were collected from risers 2 and 7, respectively. Both cores were sent to the 222-S Laboratory for analysis. Hydrostatic head fluid (HHF) was used during the sampling process. In addition to the cores, a field blank and an HHF blank were also sent to the 222-S Laboratory. Chain-of-custody forms were generated for each sample and can be located in Jo (1995a).

An anomaly occurred during the acquisition of segment 6 of core 88 (sample 95-090). A 24-hour delay occurred between the time the drill string was lowered and the time the sampler was inserted (Jo 1995a). This may have caused contamination of the segment by the HHF.

The push-mode core sampling method was chosen to obtain a vertical profile of the tank waste, as required by the safety screening DQO (Babad and Redus 1994). Primary safety screening analyses are: total alpha activity to determine criticality, DSC to ascertain the fuel energy value, and TGA to obtain the total moisture content, and vapor analyses to measure flammable gas concentrations in the tank headspace. In addition, ICP/AES was required to determine the lithium content as a check for HHF contamination. Sampling and analytical requirements from the applicable DQOs are summarized in Table 3-1. Data for anions were obtained by IC on an opportunistic basis (Kristofzski 1995). Additional ICP data were also collected and assessed on an opportunistic basis.

Table 3-1. Integrated Data Quality Objective Requirements for Tank 241-B-104.[1]

Sampling Event	Applicable DQOs	Sampling Requirements	Applicable References
Push-mode core sampling	▸Energetics ▸Moisture content ▸Total alpha ▸Flammable gas	Core samples from a minimum of two risers separated radially to the maximum extent possible.	Babad and Redus 1994; Kupfer et al. 1994

Note:
[1]Jo (1995b)

3.2 SAMPLE HANDLING

The riser 2 core sample, identified as core 88, was extruded by the 222-S Laboratory during the period June 7 through 14, 1995. The sample was composed of seven separate segments that were labeled with distinct identification numbers. Segments one through seven were identified as samples 95-085 through 95-091, respectively. Each segment had less than 5 mL of liner liquid.

The riser 7 core sample, identified as core 89, was extruded by the 222-S Laboratory during the period from June 14 through 20, 1995. The sample was composed of seven separate segments which were labeled with distinct identification numbers. Segments 1 through 7 were identified as samples 95-092 through 95-098, respectively. All segments had less than 5 mL of liner liquid except for segments 1 and 7, which had 10 and 8 mL, respectively.

Just as the extrusion process on segment 2 (sample 95-093) was completed, a power outage occurred in the 222-S Laboratory, requiring an evacuation after the first two photographs were taken. The sample was exposed to ambient hot cell conditions for two hours. After the power outage, two more photographs were taken. The sample appearance did not change within two hours and the sample did not appear to have dried significantly. However, the water results for this segment could be biased low.

Table 3-2 describes core 88 and 89 including segment numbers, phase (solid or liquid), color, texture, and amount of material recovered.

Table 3-2. Cores 88 and 89 Push-Mode Core Sample Description.[1] (2 sheets)

Segment	Sample ID	Sample Total Weight (grams)		Segment Description
		Solid	Liquid	
Core 88, Riser 2				
1	95-085	86.4	273	Recovered 86.4 g of solids and 273 g of drainable liquid. 10 to 12 cm (4 to 5 in.) of greenish-yellow sludge with black specks appeared at end of extrusion. Liquid was opaque yellow.
2	95-086	329	0	Recovered 48 cm (19 in.) of solids and no drainable liquid. Solids were moist in texture, appeared yellowish-olive in color, and had black specks.
3	95-087	402	0	Recovered 48 cm (19 in.) of solids and no drainable liquid. Solids were moist in texture, yellowish-olive in color, and had black specks.
4	95-088	380	0	Recovered 48 cm (19 in.) of solids and no drainable liquid. Solids were moist in texture, appeared yellowish-olive in color, and had black specks. Lower half of sample was very runny but last 12 cm (5 in.) of upper half retained its shape.
5	95-089	372	0	Recovered 48 cm (19 in.) of solids and no drainable liquid. Solids were yellowish-olive in color and had black specks. Sample was very wet and did not retain its shape.
6	95-090	410	0	Recovered 48 cm (19 in). of solids and no drainable liquid. Sample was a yellowish-olive moist sludge. First 5 cm (2 in.) of upper segment contained black specks and had a higher water content than other segments. Bottom 5 cm (2 in.) and top 12 cm (5 in.) did not hold its shape. Sample had a small amount of light green sludge spiraling throughout.
7	95-091	294	0	Recovered 43 cm (17 in.) of solids and no drainable liquid. Sample was a moist, yellowish-olive sludge with embedded black specks and light green sludge spiraling throughout.

Table 3-2. Cores 88 and 89 Push-Mode Core Sample Description.[1] (2 sheets)

Segment	Sample ID	Sample Total Weight (grams) Solid	Sample Total Weight (grams) Liquid	Segment Description
Core 89, Riser 7				
1	95-092	223	127	Recovered 223 g of yellow-brown to yellow-green solids and 127 g of opaque, yellow-green drainable liquid. Solids were 35 cm (14 in.) in length and had embedded black specks.
2	95-093	295	0	Recovered 48 cm (19 in.) of yellow-green to yellow-brown solids and no drainable liquid.
3	95-094	305	0	Recovered 48 cm (19 in.) of solids and no drainable liquid. Sample was yellow-olive and had a few black specks embedded in its upper-half portion. Sample was smooth, wet, and did not hold its shape.
4	95-095	360	0	Recovered 48 cm (19 in.) of solids and no drainable liquid. Sample was yellow-olive with a few black specks embedded throughout. Sample was smooth, wet, and did not hold its shape.
5	95-096	412	0	Recovered 48 cm (19 in.) of solids and no drainable liquid. Sample was yellow-olive with a few black specks embedded throughout. Sample was smooth, wet, and held its shape.
6	95-097	407	0	Recovered 48 cm (19 in.) of solids and no drainable liquid. Sample was yellow-olive with a few black specks embedded throughout. Sample was smooth, wet, and held its shape.
7	95-098	407	0	Recovered 48 cm (19 in.) of yellow-olive solids and no drainable liquid. Sample was smooth, wet, and held its shape.

Note:
[1]Jo (1995a)

The field blank was collected on June 8, 1995 and received at the 222-S Laboratory the next day. A total of 249.3 g of a clear, colorless, drainable liquid was recovered. There was no liner liquid and no problems were noted during extrusion. The HHF blank was collected on June 5, 1995 and received at the 222-S Laboratory the same day. A total of 168.4 g of slightly cloudy, pale yellow drainable liquid was recovered. There was no liner liquid and no problems were noted during extrusion.

All archiving requirements listed in the tank characterization plan were performed, including those prescribed to satisfy the pretreatment DQO.

3.3 SAMPLE ANALYSIS

For a safety evaluation, the safety screening DQO requires determination of the total alpha activity and the fuel and water contents of the waste. Because HHF was used during the sampling process, some of the percent water results may be biased high. To determine the extent of possible HHF contamination, the samples were analyzed for lithium by ICP/AES and for bromide by IC. The HHF should be the only source of lithium or bromide in the waste. Additional anion and cation results were obtained in the process of determining the concentrations of lithium and bromide as an opportunistic venture (Kristofzski 1995).

All segments were subsampled into half-segments for analysis, except for the first segment from core 88, which was analyzed on a whole segment (all solids) basis. Drainable liquid samples from the first segment of each core were also analyzed. These samples were taken after the solids had settled.

Appendix A lists the samples and the analyses performed. Sample procedures are given in Table 3-3.

Table 3-3. Analytical Procedures.[1]

Analysis	Instrument	Preparation Procedure[2]	Procedure Number[2]
Energetics by DSC	Mettler™ Perkin-Elmer™	n/a	LA-514-113, Rev. B-1 LA-514-114, Rev. B-0
Percent water by TGA	Mettler™ Perkin-Elmer™	n/a	LA-560-112, Rev. A-2 LA-514-114, Rev. B-0
Flammable gas	Combustible gas analyzer	n/a	Dome Space Vapor Survey[3]
Total alpha activity	Alpha proportional counter	LA-549-141, Rev. D-0	LA-508-101, Rev. D-2
Lithium by ICP/AES	Inductively coupled plasma spectrometer	LA-549-141, Rev. D-0 LA-505-158, Rev. A-4	LA-505-151, Rev. D-2 LA-505-161, Rev. A-1 LA-505-148, Rev. A-4
Anions by IC	Ion chromatograph	LA-504-101, Rev. D-0	LA-533-105, Rev. C-2 LA-533-105, Rev. D-1

Notes:

n/a = not applicable
Rev. = revision
Mettler™ is a registered trademark of Mettler Electronics, Anaheim, California.
Perkin-Elmer™ is a registered trademark of Perkins Research and Manufacturing Company, Inc., Canoga Park, California.

[1]Jo (1995a)

[2]Procedures of Westinghouse Hanford Company, Richland, Washington.

[3]Stanton, G. A., 1996, *Data Sheet 1 - Dome Space Vapor Survey*, (facsimile transmission to J. G. Douglas and J. Jo, March 26), Westinghouse Hanford Company, Richland, Washington.

4.0 ANALYTICAL RESULTS

4.1 OVERVIEW

This section presents the analytical results associated with the sampling of tank 241-B-104. The required analyses are based on the DQO process. The DQOs that govern the sampling and subsequent sample analysis for tank 241-B-104 are the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) and the *Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994).

Analyses were performed on the half-segment level, with the exception of the first segment from core 88, which was mostly free-standing or drainable liquid; thus, subsampling was deemed inappropriate. In addition to the analyses required by the tank characterization plan, analyses were performed on an opportunistic basis for selected cations and anions in accordance with Kristofzski (1995). Although bromide analysis by IC is only required when lithium concentrations exceed the notification limit, bromide concentration was determined for each solid sample. Table 4-1 details the tabulated location of data within this document.

Table 4-1. Data Locations.

Analyte	Tabulated Location
Percent moisture	Tables 4-2 and 4-3
Energetics	Table 4-4
Anions	Table 4-5
Metals	Table 4-6
Flammable gas	Table 4-8
1995 analytical data set	Appendix A
Hydrostatic head fluid contamination check data	Appendix B

An overall mean was calculated for all analytes by averaging concentration values for the core samples obtained from risers 2 and 7. The results for each sample and duplicate pair were averaged, giving a half-segment mean (a whole-segment mean in the case of segment 1 of core 88). The half-segment means were then averaged to obtain a segment mean, and the segment means were averaged to obtain a core mean. The two core means were then averaged to obtain an overall tank mean. Individual sample results and their respective duplicate results are reported in Appendix A of this report, while only a mean value and a relative standard deviation (RSD) for each sample are reported in this section. This procedure was followed carefully to ensure that each subsegment, segment, and core were weighted equally in the calculation of an overall tank mean. This treatment also allows the concentration estimate to be as spatially balanced as possible, and was determined to be the best approach to obtain a good statistical analysis.

In addition to the overall mean, a projected tank inventory was calculated for all analytes. The projected inventory is the product of the concentration of the analyte and the amount of waste in the tank (1,400 kL [369 kgal]), and an estimated density of 1.38 g/mL (Brevick et al. 1994a). (Note: This density is based on historical data and contains unknown errors.)

4.2 TOTAL ALPHA

The total alpha analyses were performed on a fusion digested sample with an alpha proportional counter according to procedure LA-508-101, Rev. D-2. No profiles were observed from the core samples. Values were consistent in both cores across the tank and as a function of depth. All total alpha results were well below the DQO notification limit of 41.0 μCi/g, with the highest observed value of any sample or duplicate being 0.0838 μCi/g. The overall tank average for total alpha was 0.0440 μCi/g, and RSD of the mean was 22.3 percent. The upper limit to a one-sided 95 percent confidence interval on the mean was 0.21 μCi/g. Appendix Table A-2 presents the data for total alpha from tank 241-B-104. The table identifies the sample by number, core, segment, and segment portion. Quality control problems were noted in the 90-Day report (Jo 1995a), but corrective actions were not requested for most of the analyses because of the low alpha activities compared to the notification limit. Further discussion of quality control tests and results can be found in Section 5.1.2.

4.3 THERMODYNAMIC ANALYSES

The only physical analyses required by the tank characterization plan (Jo 1995b) were TGA and DSC. Density, percent solids, particle size, and rheology were neither requested nor performed.

4.3.1 Thermogravimetric Analysis

In TGA, the mass of a sample is measured while its temperature is increased at a constant rate. Any decrease in the weight of a sample represents a loss of gaseous matter from the sample either through evaporation or through a reaction that forms gas phase products. No lateral heterogeneity was apparent from the data. The tank appears to be homogeneous in water content except for drainable liquid in the top segment of both risers sampled.

Weight percent water by TGA was performed under a nitrogen purge using procedures LA-560-112, Rev. A-2, and LA-514-114, Rev. B-0. The lowest percent water result was 28.08, from sample number S95T001068 (core 88, upper half of segment 4). The overall average for the tank solids was 46.9 weight percent water, with an overall RSD of the mean of 2.0 percent. The lower limit to a one-sided 95 percent confidence interval on the mean percent water, using the full TGA data set, was 34.02 percent. This limit is larger than the threshold value of 17 percent. Problems with RPDs between initial and duplicate analyses resulted in the reanalysis of three samples (S95T001049, S95T001068, and S95T001076). This is further discussed in Section 5.1.2. The overall average for the drainable liquid samples was 52.1 weight percent water, with an RSD of the mean of 2.5 percent. Results of the solids TGA are presented in Table 4-2, while drainable liquid results are provided in Table 4-3.

Table 4-2. Solids Thermogravimetric Analysis Results for Tank 241-B-104.[1] (2 sheets)

Sample Number	Sample Location	Temperature Range	Result	Duplicate	Mean
	Segment (Portion)	°C	% H_2O	% H_2O	% H_2O
Core 88, Riser 2					
1049	1 (Whole)	32-186	61.19	42.34	51.77
1054	2 (Upper half)	35-189	40.90	44.75	42.83
1055	2 (Lower half)	22.59-210.2	49.93	49.14	49.53
1062	3 (Upper half)	32-200	44.18	40.79	42.48
1061	3 (Lower half)	22.59-210.2	46.69	47.98	47.33
1068	4 (Upper half)	30-182	42.50	28.08	35.29
1067	4 (Lower half)	32-189	46.69	44.72	45.70
1076	5 (Upper half)	35-175	49.84	44.24	47.04
1075	5 (Lower half)	35-190	48.98	48.39	48.69
1092	6 (Upper half)	22.50-228.3	45.15	46.11	45.63
1091	6 (Lower half)	26.02-227.2	46.15	46.26	46.20
1100	7 (Upper half)	32-200	46.20	47.65	46.92
1099	7 (Lower half)	35-180	44.64	44.37	44.50

Table 4-2. Solids Thermogravimetric Analysis Results for Tank 241-B-104.[1] (2 sheets)

Sample Number	Sample Location	Temperature Range	Result	Duplicate	Mean
	Segment (Portion)	°C	% H_2O	% H_2O	% H_2O
Core 89, Riser 7					
1108	1 (Upper half)	20.66-222.9	46.64	45.46	46.05
1107	1 (Lower half)	21.34-230.1	47.84	47.14	47.49
1114	2 (Upper half)	23.76-230.8	48.32	48.13	48.23
1113	2 (Lower half)	26.03-228.0	47.16	47.09	47.12
1131	3 (Upper half)	32-185	47.63	47.55	47.59
1130	3 (Lower half)	32-188	47.93	46.20	47.06
1137	4 (Upper half)	32-190	48.17	48.24	48.20
1136	4 (Lower half)	32-187	46.97	47.23	47.10
1143	5 (Upper half)	32-190	49.80	49.08	49.44
1142	5 (Lower half)	35-195	47.12	47.40	47.26
1149	6 (Upper half)	32-190	46.98	47.07	47.02
1148	6 (Lower half)	32-190	50.27	48.02	49.15
1155	7 (Upper half)	32-190	46.62	46.56	46.59
1154	7 (Lower half)	32-195	47.88	47.82	47.85
Mean Weight Percent Water = 46.9%					
Relative Standard Deviation of the Mean = 2.0%					

Note:
[1]Jo (1995a)

Table 4-3. Drainable Liquid[1] Thermogravimetric Analysis Results for Tank 241-B-104.[2]

Sample Number	Core	Segment	Temperature Range °C	Result % H_2O	Duplicate % H_2O	Mean % H_2O
1051	88	1	35-162	51.68	49.90	50.79
1104	89	1	35-158	53.69	53.11	53.40
Mean Weight Percent Water = 52.1%						
Relative Standard Deviation of the Mean = 2.5%						

Note:

[1]Free-standing separable liquid from the solid waste matrix.

[2]Jo (1995a)

4.3.2 Differential Scanning Calorimetry

In DSC analysis, heat absorbed or emitted by a substance is measured while the substance is exposed to a linear increase in temperature. The onset temperature for an endothermic (characterized by or causing the absorption of heat) or exothermic (characterized by or causing the release of heat) event is determined graphically.

Analyses by DSC were performed under a nitrogen atmosphere using procedure LA-514-113, Rev. B-1, using a Mettler™ Model 20 differential scanning calorimeter, and procedure LA-514-114, Rev. B-0, using Perkin-Elmer™ equipment. No exothermic reactions were observed. No problems with quality control were noted.

The DSC results are presented in Table 4-4. The sample weight, temperature at maximum enthalpy change, and the magnitude of the enthalpy change are provided for each transition. The first transition represents the endothermic reaction associated with the evaporation of free and interstitial water. The second transition probably represents the energy (heat) required to remove additional bound water from other hydrated compounds. Other phenomenon observed in tanks, such as dehydration of aluminum hydroxide or melting salts such as sodium nitrate, were not apparent in tank B-104. This is expected from the small ΔH in transition 2 (see Table 4-4). The sign convention for representing exotherms is negative, and for endotherms is positive. Because only endotherms were observed, all reported values were positive.

Table 4-4. Differential Scanning Calorimetry Results for Tank 241-B-104.[1] (3 sheets)

Sample Number	Segment	Segment Portion	Run	Sample Weight (mg)	Transition 1		Transition 2	
					Peak (°C)	ΔH (J/g)	Peak (°C)	ΔH (J/g)
Core 88, Riser 2								
1049	1	Whole segment	1	14.94	121.7	568.7	297.9	46.77
			2	10.90	118.9	807.1	301.0	50.62
1051		Drainable liquid	1	14.77	147.7	971.3	298.5	81.1
			2	14.39	120.4	1,282	298.5	77.3
1054	2	Upper ½	1	11.70	114.2	946.7	299.0	54.46
			2	10.29	90.12	775.5	300.3	51.29
1055		Lower ½	1	10.11	90.2	982.3	298.7	70.0
			2	13.12	91.5	1,079	298.5	81.8
1062	3	Upper ½	1	8.541	123.4	1,642	298.8	127.3
			2	10.54	153.0	1,323	298.4	108.2
1061		Lower ½	1	19.12	123.5	947.6	297.9	104.4
			2	23.46	121.3	1,351	297.7	99.6
1068	4	Upper ½	1	16.08	97.5	1,010	298.3	81.3
			2	11.30	108.0	1,023	298.7	73.8
1067		Lower ½	1	35.40	115.3	1,002	297.1	67.7
			2	16.10	103.3	1,054	298.3	69.8
1076	5	Upper ½	1	20.74	119.4	962.7	301.1	46.74
			2	18.29	106.0	1,014	300.2	52.56
1075		Lower ½	1	18.15	120.9	871.5	302.3	44.23
			2	21.39	121.6	825.5	301.9	44.08
1092	6	Upper ½	1	22.89	104.5	897.2	301.5	41.14
			2	16.65	86.88	811.6	300.5	46.81
1091		Lower ½	1	15.28	103.4	845.9	300.6	42.23
			2	14.67	123.7	822.1	302.1	45.16
1100	7	Upper ½	1	13.34	113.1	1,155	298.5	70.9
			2	10.91	101.7	1,077	298.6	71.3
1099		Lower ½	1	19.51	104.7	934.9	298.1	67.7
			2	17.37	97.7	572.7	298.6	45.4

Table 4-4. Differential Scanning Calorimetry Results for Tank 241-B-104.[1] (3 sheets)

Sample Number	Segment	Segment Portion	Run	Sample Weight (mg)	Transition 1		Transition 2	
					Peak (°C)	ΔH (J/g)	Peak (°C)	ΔH (J/g)
Core 89, Riser 7								
1108	1	Upper ½	1	12.13	105.0	905.4	300.4	43.96
			2	21.87	122.2	576.2	303.4	28.74
1107		Lower ½	1	19.93	123.7	623.3	302.3	32.1
			2	12.75	100.7	946.8	300.7	45.94
1104		Drainable liquid	1	10.14	122.1	1,813	298.3	129.2
			2	14.25	127.3	1,176	296.3	81.6
1114	2	Upper ½	1	18.24	117.3	994.7	301.0	48.33
			2	20.28	115.3	984.7	300.6	45.04
1113		Lower ½	1	17.05	124.9	857.6	303.3	41.06
			2	13.58	86.19	779.8	302.8	44.61
1131	3	Upper ½	1	17.37	106.7	867.0	298.4	72.7
			2	16.46	122.9	856.3	300.6	64.5
1130		Lower ½	1	17.31	125.1	772.1	289.7	56.7
			2	15.16	107.5	927.1	298.6	67.7
1137	4	Upper ½	1	17.93	112.6	988.7	298.3	72.0
			2	16.88	109.0	959.6	298.4	74.0
1136		Lower ½	1	23.23	118.2	977.3	299.9	78.0
			2	22.81	122.5	964.6	298.1	73.0
1143	5	Upper ½	1	14.74	120.3	1,307	298.2	94.6
			2	16.66	124.7	887.1	298.5	65.3
1142		Lower ½	1	14.92	125.4	891.4	298.6	69.0
			2	15.89	99.2	876.7	298.4	69.1
1149	6	Upper ½	1	20.17	122.8	812.0	298.4	63.4
			2	17.77	123.0	1,061	298.4	66.0
1148		Lower ½	1	35.89	113.3	886.2	299.1	76.3
			2	30.00	117.3	1,012	299.7	64.5

Table 4-4. Differential Scanning Calorimetry Results for Tank 241-B-104.[1] (3 sheets)

Sample Number	Segment	Segment Portion	Run	Sample Weight (mg)	Transition 1		Transition 2	
					Peak (°C)	ΔH (J/g)	Peak (°C)	ΔH (J/g)
Core 89, Riser 7								
1155	7	Upper ½	1	16.55	123.1	859.9	298.5	65.1
			2	18.30	120.8	853.2	298.5	65.2
1154		Lower ½	1	29.72	119.3	865.1	297.7	63.2
			2	18.13	123.3	832.4	298.4	56.2

Note:
[1]Jo (1995a)

4.4 ION CHROMATOGRAPHY ANALYSIS

Additional anions were detected during the IC analysis for bromide. A summary of the results for these anions is provided in Table 4-5. The full data set can be found in Appendix A. Note that the bromide results are not included in Table 4-5; bromide was analyzed to check for hydrostatic head fluid contamination and is not considered to be a constituent of the tank waste (see Section 4.6.2). The IC analysis was not performed on any of the drainable liquid samples.

The overall means, RSDs of the mean, and projected inventories given in Table 4-5 were taken from Appendix A. The overall means were derived by weighting each segment and core equally. The projected inventories were calculated using a density of 1.38 g/mL (Brevick et al. 1994a) and a solid waste volume of 1.40E+06 liters (3.70E+05 gallons) (Hanlon 1995). (Note: Density is based on historical information; hence, inventory calculations contain unknown errors.)

Table 4-5. Ion Chromatography Analytical Results.[1]

Analyte	Overall Mean	RSD (Mean)	Projected Inventory[2]
	µg/g	%	kg
Chloride	2,110	4.2	4,080
Fluoride	3,460	20.6	6,680
Nitrate	2.90E+05	4.8	5.60E+05
Nitrite	2,450	8.7	4,730
Oxalate	< 1,470	n/a	< 2,840
Phosphate	23,300	3.8	45,000
Sulfate	21,400	9.1	41,300

Note:

[1]Jo (1995a)

[2]Calculations are based on historical density estimates, and contain unknown errors.

4.5 INDUCTIVELY COUPLED PLASMA (ICP) ANALYSIS

Additional cations were detected during the ICP analysis for lithium. Because the ICP analyses were performed primarily for lithium, a fusion test was conducted using potassium hydroxide for extraction, and nickel or zirconium crucibles. As a result, potassium, nickel and zirconium results could not be obtained from these analyses. Results for cations required by historical requirements or critical to mass balance calculations are provided in Table 4-6 and Appendix A. Note that the lithium results are not included in Table 4-6. Like bromide, lithium was analyzed to check for hydrostatic fluid contamination and is not considered to be a constituent of the tank waste. This is further discussed in Section 4.6.

The overall means, RSDs, and projected inventories in Table 4-6 were taken from Appendix A and were derived as specified in Section 4.4.

Table 4-6. ICP Analytical Results[1]

Analyte	Overall Mean	RSD (Mean)	Projected Inventory[2]
METALS	μg/g	%	kg
Al	1,843	39	3,560
Bi	11,425	24	22,050
Ca	328	31	630
Cr	513	33	990
Fe	10,794	13	20,830
P	17,043	15	32,890
Na	117,150	9	226,100
S	7,284	12	14,060
Si	5,697	20	11,000
U	<1920	NA	3,700

Note:

[1]Jo (1995a)

[2]Calculations are based on historical density estimates, and contain unknown errors.

4.6 ANALYSIS FOR HYDROSTATIC HEAD FLUID CONTAMINATION

Water was used as a hydrostatic head fluid in the acquisition of cores 88 and 89. Lithium bromide was added to the HHF to act as a tracer. Analyses for lithium and bromide were performed in accordance with the tank characterization plan (Jo 1995b) to detect contamination of the waste samples with HHF. All subsegments and both drainable liquid samples from each core were analyzed for lithium. All subsegments from both cores were analyzed for bromide.

4.6.1 Lithium

Lithium was analyzed by ICP using procedures LA-505-151, Rev. D-2, and LA-505-161, Rev. A-1. Solid subsamples were prepared by fusion in accordance with procedures LA-549-141, Rev. D-0, and LA-505-158, Rev. A-4. Liquid subsamples were either analyzed directly or after dilution with acid according to procedure LA-505-148, Rev. A-4. No results were greater than the tank characterization plan notification limit of 100 μg/g (Jo 1995b). The upper half of core 88 segment four, both halves of core 89 segment two, both halves of core 89 segment four, and the lower half of core 89 segment 7 exhibited lithium results greater than the analytical detection limit (see Table 4-7). The analytical results for lithium are presented in Appendix B. Note that no projected inventory was calculated for lithium. This is because lithium is not a constituent of the waste, but is an artifact of sampling operations.

Table 4-7. Lithium and Bromide Tracer Results Greater Than Analytical Detection Limits.

		Lithium		Bromide	
Core	Segment	Sample	Mean (µg/g)	Sample	Mean (µg/g)
89	2 Upper	S95T001116	44.56	S95T001850	598.5
89	2 Lower	S95T001115	23.69	S95T001849	509.5
89	4 Upper	S95T001139	21.58	S95T001854	484.5
89	4 Lower	S95T001138	6.14		
89	5 Lower			S95T001855	658.5
89	7 Lower	S95T001156	48.90		
88	4 Upper	S95T001072	14.11		
88	6 Upper			S95T001831	501.5
88	6 Lower			S95T001830	356.5

(see Appendix B for more information)

4.6.2 Bromide

Bromide was analyzed by IC using procedure LA-533-105, Rev. C-2 and D-1, after preparation using procedure LA-504-101, Rev. D-0. Bromide analyses are required when lithium results exceed the notification limit listed in Jo (1995b). Although the lithium results were all well within the limit, bromide analyses were performed because of concerns that the lithium results may have been biased low because of lithium precipitation and subsequent non-detection. Both segment portions from core 88 segment six and core 89 segment two, the upper half of core 89 segment four, and the lower half of core 89 segment five exhibited results greater than the detection limit. However, none of the results were greater than the notification limit of 1,200 µg/g. Note that no bromide analyses were performed on the drainable liquid samples. Results for the bromide analyses are listed in Appendix B. A projected inventory was not calculated for bromide because, like lithium, it is an artifact of sampling, and not a waste constituent.

4.7 HEADSPACE VAPOR SAMPLING

A vapor survey was conducted in riser #2 in March 1996 to analyze headspace vapors below the riser. Results from the survey are shown in Table 4-8. The results show that gas concentration was at 0% of the LFL. No total organic carbon was found in the headspace.

Table 4-8. Headspace Vapor Survey Results.

Flammability	Results
LFL headspace	0%
Vapor	**Results**
TOC (headspace)	1.8 ppm
NH_3 (headspace)	0 ppm

Notes:

LFL = lower flammability limit
TOC = total organic carbon

5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

The purpose of this chapter is to evaluate the overall quality and consistency of the available results for tank 241-B-104 and to assess and compare these results against historical information and program requirements.

5.1 ASSESSMENT OF SAMPLING AND ANALYTICAL RESULTS

This section evaluates sampling and analysis factors that may impact interpretation of the data. These factors are used to assess the overall quality and consistency of the data and to identify any limitations in the use of the data.

5.1.1 Field Observations

The safety screening DQO (Babad and Redus 1994) requirement that at least two widely spaced risers be sampled was fulfilled. Sample recovery was good for all segments from both risers and HHF intrusions were all below the notification limits. It was observed that for segment 6 of core 88, a 24-hour delay occurred between the time the drill string was lowered and the time the sampler was inserted. This occurrence most likely did not impact data quality.

5.1.2 Quality Control Assessment

The quality control assessment includes an evaluation of the four quality control checks (blanks, duplicates, spikes, and standards) performed in conjunction with the chemical analyses. Because of the large amount of data collected for tank 241-B-104, this section provides only a general evaluation and summary of some key safety areas. The original data report (Jo 1995a) should be consulted for more detailed quality control information. The sampling and analysis plan (Jo 1995b, Appendix A) establishes the specific accuracy and precision criteria for the four quality control checks. Samples that had one or more quality control results outside of the criteria have been identified (by footnoting) in the Appendix A data tables.

Several quality control results for the total alpha activity standard and spike recoveries were outside the quality control criteria. However, these deviations were not significant enough to affect the criticality evaluation.

The precision (estimated by the relative percent difference [RPD], defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times one hundred) for the safety screening analytes also exceeded the limits for a few samples. There were no RPDs for DSC because there were no exothermic reactions, and lithium had no RPDs outside the limits. Percent water had two RPDs exceeding the criterion, and total alpha activity had five outside the limits. The total alpha activity violations were due to analyte concentrations ten times less than the detection limit and slightly higher (Appendix A). Good precision is difficult to achieve when analyte concentrations are low and RPD results are not meaningful.

Preparation blanks are used to identify any sample contamination that was introduced in the laboratory during the process of sample breakdown, digestion, and dilution. All blanks were less than one percent of the analytical results. Thus, contamination was not a problem.

The opportunistic analytes for this tank include seven anions in addition to the bromide analyzed to check for HHF contamination. The quality control (QC) parameters for these analytes were established by the laboratory, and are the same as those established for the primary analytes. Although some violations occurred (see Appendix A), all standards conducted on the anions were within the defined criterion. As with the safety screening analytes, several of the violations were due to the analytical results being below ten times the detection limit.

ICP analytes identified in Appendix A met all quality control checks. Only ICP analytes required for mass balance calculations or historical DQOs were assessed. Other ICP analytes identified in Jo (1995a) may not meet QC checks because potassium hydroxide fusion analyses were conducted primarily for lithium analyses.

5.1.3 Data Consistency Checks

Comparisons of different analytical methods were conducted to assess the consistency and quality of the data. Data consistency checks included comparing sulfur and phosphorous concentrations as determined by ICP/AES with sulfate and phosphate as measured by IC and calculation of a mass and charge balance. Because of the lack of radionuclide data other than total alpha activity, radionuclide data checks were not possible.

5.1.3.1 Comparison of ICP Sulfur and IC Sulfate Analyses. When the ICP sulfur results were converted to sulfate and compared to the ion chromatographic sulfate result, the results differed by only 2 percent. This indicates that the sulfur is 100% soluble as the SO_4 ion.

5.1.3.2 Comparison of ICP Phosphorus and IC Phosphate Analyses. When the ICP phosphorus results were converted to phosphate and compared to the ion chromatographic phosphate result, the results differed by 45 percent. This indicates that the phosphate is 45 percent soluble.

5.1.3.3 Mass and Charge Balance. The principal objective in performing a mass and charge balance is to determine if the measurements are consistent. In calculating the balances, only sludge phase analytes listed in Table 5-1 were considered.

With the exception of sodium and bismuth (assumed to be $BiPO_4$), all cations listed in Table 5-1 were assumed to be present in their most common hydroxide or oxide forms, and the concentrations of the assumed species were calculated stoichiometrically. There may be some argument whether or not certain species are hydroxides or oxides, but the difference in molecular weight has a minimal effect on the overall mass balance. Although smaller concentrations of other forms of the species are also present in the waste, they are not included in order to keep the mass-charge balance calculations simple and consistent.

Because precipitates are neutral species, all positive charge was attributed to the sodium cation. The anionic analytes listed in Table 5-2 were assumed to be present as sodium or potassium salts and were expected to balance the positive charge. Total organic carbon and total inorganic carbon were not measured based on historical models for the tank and are assumed to be zero. The concentrations of the assumed species in Table 5-1, of the anionic species in Table 5-2, and the percent water were used to calculate the mass balance, are shown in Table 5-3.

The mass balance was calculated from the following formula. The factor 0.0001 is the conversion factor from $\mu g/g$ to weight percent.

$$\text{Mass balance} = \%\ \text{Water} + 0.0001 \times \{\text{Total Analyte Concentration}\}$$
$$= \%\ \text{Water} + 0.0001 \times \{Al(OH)_3 + BiPO_4 + CaO + Cr(OH)_3 + FeO(OH) +$$
$$Pb(OH)_2 + U_3O_8 + Na^+ + Cl^- + F^- + SiO_3^{2-} + NO_3^- + NO_2^- + \text{Net } PO_4^{3-} + SO_4 2\}.$$

The analyte concentrations from the preceding equation totaled 544,000 $\mu g/g$. The mean weight percent water in the sludge was determined to be 46.9 percent. The mass balance resulting from adding the percent water to the total analyte concentration is 101.3 percent.

Table 5-1. Cation Mass and Charge Data.[1]

Analyte	Concentration ($\mu g/g$)	Assumed Species	Concentration of Assumed Species ($\mu g/g$)	Charge ($\mu mol/g$)
Aluminum	1,843	$Al(OH)_3$	5,325	0
Bismuth	11,425	$BiPO_4$	16,665	0
Calcium	328	CaO	460	0
Chromium	513	$Cr(OH)_3$	990	0
Iron	10,794	Fe(O)(OH)	17,190	0
Sodium	117,150	Na^+	117,150	5,090
Uranium	<1,920	U_3O_8	4,370	0
Totals			162,150	5,090

Note:

[1]Jo (1995a)

Table 5-2. Anion Mass and Charge Data.[1]

Analyte	Concentration ($\mu g/g$)	Charge ($\mu mol/g$)
Chloride	2,110	60
Fluoride	3,460	182
Nitrate	290,000	4,680
Nitrite	2,450	53
Net phosphate[2]	46,925	165
Silicate[2]	15,460	102
Sulfate	21,400	111
Totals	381,805	5,353

Notes:

[1]Jo (1995a)

[2]Calculated from ICP data; PO_4^{3-} with Bi is excluded.

Table 5-3. Mass Balance Totals.

	Concentrations ($\mu g/g$)
Total from Table 5-1	162,150
Total from Table 5-2	381,805
Water	469,000
Grand Total	1,012,955

The charge balance is the ratio of total cations (microequivalents) to total anions (micro equivalents) with respect to the species listed below, which were assumed to be water soluble.

Total cations (microequivalents) = $Na^+/23.0$
The total cation charge, 5,090 μmol/g, is calculated in Table 5-1.

Total anions (microequivalents)
$= Cl^-/35.5 + F^- + NO_3^-/62.0 + NO_2^-/46.0 + \text{Net } PO_4^{3-}/31.7 + SiO_3^{2-}/38.0 + SO_4^{2-}/48.0$

The total anion charge, 5,353 μmol/g, is calculated in Table 5-2.

The ratio of microequivalents of total cations to microequivalents of total anions was 0.95; a perfect charge balance would yield a ratio equivalent to 1.00. The slightly lower cation charge may be due to neglecting K^+.

5.2 COMPARISON OF ANALYTICAL RESULTS FROM DIFFERENT SAMPLING EVENTS

No previous sampling data exist; therefore, no comparisons between current and historical analytical results were possible.

5.3 TANK WASTE PROFILE

In June 1995, core samples were taken from two widely spaced risers to obtain a vertical profile of the waste (Jo 1995b). No serious problems were encountered during the sampling and extrusion, and sample recovery was good. Homogenization difficulties are often a cause of data variability; however, no homogenization problems were noted. A vertical profile was obtained from both risers, satisfying the sampling objective and allowing a statistical assessment of the vertical (and horizontal) distribution of the tank waste for several analytes. Information on the vertical disposition of the waste was also available from the TLM (Agnew et al. 1995a) (Figure 2-3). According to the TLM, the waste is composed of up to five layers. The top layer is a small quantity of supernatant, the presence of which was confirmed by the sampling event. The next layer was predicted to be B Saltcake, followed by a layer of unknown waste (probably 1C or B Saltcake), and a layer of 1C waste. The bottom portion was predicted to be 2C waste. These different layers imply that the tank contents were expected to be vertically heterogeneous. However, the visual descriptions of the samples indicated that the waste appeared to be fairly uniform with depth, as most segments from both cores were described as being moist sludge, yellow-olive in color, and with a few black specks embedded.

The fact that two risers and multiple segments were sampled allowed a statistical analysis of variance (ANOVA) to be conducted on the 1995 core samples in order to determine whether there were vertical or horizontal variations in the analyte concentrations. The ANOVA model used was a random effects nested model, and only those analytes that had greater than half of their individual measurements above the detection limit were analyzed. The ANOVA generates a p-value that is compared with a standard significance level ($\alpha = 0.05$). If a p-value is below 0.05, there is sufficient evidence to conclude that the sample means are significantly different from each other. However, if a p-value is above 0.05, there is not sufficient evidence to conclude that the samples are significantly different from each other.

The results of the ANOVA indicated that 3 of the 17 analytes tested showed significant concentration differences between the cores. These were fluoride (p-value = 0.004), sulfate (p-value = 0.047), and aluminum (p-value = 0.002). At the segment level, significant differences were found for three of the analytes: bismuth, sulfur, and silicon (p-values =

0.036, 0.090, and 0.033, respectively). On the subsegment level, however, all of the analytes showed at least one significant difference except percent water (p-value = 0.269). The variation (or lack thereof) between segments is dependent on the variation between the subsegments, whereas the variation between subsegments is dependent on the analytical error. Thus, the segment level results are probably most indicative of the true vertical disposition of the waste.

In summary, based on the visual descriptions of the samples and the statistical results, the tank contents appear to be fairly homogeneous in both the vertical and horizontal directions. This result conflicts with HTCE estimates and TLM, which identify several waste types and layers (see Section 2.3.2).

5.4 COMPARISON OF TRANSFER HISTORY WITH ANALYTICAL RESULTS

The HTCE estimates for tank 241-B-104 (Brevick et al. 1994a) and tank layer model (TLM) estimates (Agnew et al. 1995a) are compared with the analytical results from the 1995 sampling event in Table 5-4. There is poor correlation between the HTCE data and analytical results (Table 5-4). It was noted that HTCE means were much closer to analytical results prior to the latest revision of the HTCE (Agnew et al. 1995a). TLM comparisons in Table 5-5 were included to compare different waste types and corresponding core segments where these waste types were predicted. Three major differences were noted.

First, the HTCE and TLM identify three types of layered waste and an unknown layer in this tank. Major waste constituents by waste type are identified in Section 2.3 and Appendix A. B Saltcake is expected to differ from 1C/2C sludge layers by having a higher concentration of chloride, a lower percent water, and a substantially lower iron concentration. These expectations were not fulfilled by the analytical data. As noted in the previous section, no vertical or horizontal stratification was observed in any of the samples, and there was no significant difference in the concentration of analytes at different depths. It appears from the data that there may have been some natural mixing of the different waste types, resulting in tank contents that are relatively homogeneous.

Second, the tank is much drier than predicted. The HTCE-estimated water content of the sludge was 65.4 percent. The water content measured was 46.9 percent. Some drying is expected due to evaporative losses not accounted for by the HTCE model. The differences in water content may be largely responsible for many of the differences in soluble ion concentrations.

Finally, compared to HTCE estimates, tank concentrations are almost an order of magnitude higher for NO^-_3, slightly higher for SO^{2-}_4, and about two times lower for PO^{3-}_4. This exceeds any expected differences accounted for by the bias attributable to higher water content.

Table 5-4. Comparison of Historical Estimates with 1995 Analytical Results for Tank 241-B-104.

Analyte	1995 Analytical Result	HTCE Estimate
IONS	μg/g	μg/g
Chloride	2,110	687
Fluoride	3,460	7,220
Nitrate	290,000	52,300
Nitrite	2,450	3,050
Phosphate	23,300	90,900
Sulfate	21,400	11,700
METALS		
Aluminum	1,843	11,900
Bismuth	11,425	12,900
Calcium	328	-
Chromium	513	297
Iron	10,794	21,800
Sodium	117,150	104,000
Silicon	5,697	3,610
RADIONUCLIDES	μCi/g	μCi/g
Total Alpha	0.0440	0.00661 (Pu)
PHYSICAL PROPERTIES	%	%
Percent Water	46.9	65.4

Table 5-5. Tank Layer Model and 1995 Sample Results Comparison for Predicted Corresponding Segments ($\mu g/g$).

Analyte	2C1	Segment 7	1C2	Segment 5	B Saltcake	Segment 1
Na	75,100	118,700	66,700	118,900	144,000	119,000
Al	0	1,509	19,000	1,600	2,017	1,640
Fe	25,100	11,200	8,170	10,900	436	10,800
Cr	140	530	185	520	223	510
Bi	15,500	11,800	7,550	12,000	379	12,100
Ca	4,600	390	1,490	350	1,410	340
NO_3	35,700	264,000	19,800	288,000	234,000	295,000
NO_2	61	2,300	9,300	2,200	9,810	1,670
PO_4	74,400	22,600	68,000	23,000	47,400	21,200
SO_4	3,030	20,400	4,050	21,500	10,800	18,650
SiO_3	1,760	15,900	1,150	15,700	429	15,200
F	2,660	3,600	2,980	3,000	2,000	3,440
Cl	680	2,100	374	2,200	2,490	2,080
H_2O	72.7	46.3	78.3	48.0	53.2	49.3
Mass Balance (%)		95		97		98
Charge Balance (Cation:Anion)		1.07		1.00		0.98

5.5 EVALUATION OF PROGRAM REQUIREMENTS

Tank 241-B-104 is classified as a non-Watch List tank. This section details the data needs as defined in the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), and the *Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994), and determines whether tank 241-B-104 has been appropriately categorized concerning safety issues. The safety screening DQO establishes decision criteria or notification limits for concentrations of analytes of concern. The decision criteria are used to assess tank safety and determine if further investigation is warranted. If results from one of the primary analyses exceed any of the decision criteria, further analyses are conducted to assure the safety of the tank (Babad and Redus 1994).

5.5.1 Safety Evaluation

The primary analytical requirements identified in the safety screening DQO for a safety evaluation were energetics, total alpha activity, moisture content, and flammable gas concentration. The 1995 core sampling event and 1996 vapor survey are expected to meet all the requirements of this DQO. The requirement that a vertical profile of the tank be obtained from at least two widely spaced risers was also met. Table 5-6 lists the safety issue, the applicable analytes, their notification limits, and their analytical results.

The waste fuel energy value was determined by DSC. No exothermic reactions were observed in any of the 1995 safety screening samples.

Large amounts of moisture reduce the potential for propagating exothermic reactions in the waste. All of the primary and duplicate samples for percent water were above the 17 percent criterion as determined by TGA, with a mean concentration of 46.9 percent. The lower limit to a one-sided 95 percent confidence interval on the mean was 34.02 percent.

The potential for criticality can be assessed from the total alpha activity. None of the individual samples from the 1995 data contained total alpha activity greater than 0.0838 μCi/g, and the mean result was 0.054 μCi/g. The upper limit to a one-sided 95 percent confidence interval on the mean was 0.21 μCi/g. This was well below the notification limit of 41.0 μCi/g, or 1 g/L, as specified in the safety screening DQO (see footnote 1 of Table 5-6).

Table 5-6. Safety Screening DQO Decision Variables and Criteria.

Safety Issue	Primary Decision Variable	Decision Criteria Threshold	Analytical Result
Ferrocyanide/ Organics	Total Fuel Content	-481 J/g (115 calories/gram)	No exotherms
Organics	Percent Moisture	17 weight %	Mean = 46.9 Lowest value = 28.1
Criticality	Total Alpha	1 g/L (41.0 μCi/g)[1]	Mean = 0.054 μCi/g Highest value = 0.0838 μCi/g
Flammable Gas	Flammable Gas	< 12% of LFL	0 %

Note:

[1]To convert g/L to μCi/g for total alpha, it was assumed that all alpha decay alpha decay originated from ^{239}Pu. Assuming a density of 1.5 g/mL and specific activity of ^{239}Pu (0.0615 Ci/g) the conversion is as follows:

$$\left(\frac{1\ g}{L}\right)\left(\frac{1\ L}{10^3\ mL}\right)\left(\frac{1\ mL}{1.5\ g}\right)\left(\frac{0.0615\ Ci}{1\ g}\right)\left(\frac{10^6\ \mu Ci}{1\ Ci}\right) = \frac{41.0}{density}\frac{\mu Ci}{g}$$

The flammability of the gas in the headspace of the tank was assessed based on a vapor survey. Only 1.8 ppm of organic carbon, and no ammonia, was detected. The concentration of gases was determined to be at 0 % of the LFL.

Another factor in assessing the safety of the tank waste is the heat generation and temperature of the waste. Heat is generated in the tanks from radioactive decay. The only available estimate of the heat load was the HTCE value of 0.0428 kW (146 Btu/hr). This was well below the criterion of < 11.7 kW (39,900 Btu/hr) that separates a high- from a low-heat load tank (Bergmann 1991). Because an upper temperature limit was exhibited (Section 2.4.2), it may be concluded that any heat generated from radioactive sources throughout the year is dissipated.

5.5.2 Pretreatment Evaluation

This requirement was met by sending samples to Los Alamos National Laboratory for future analysis to characterize for pretreatment and/or disposal.

5.5.3 Historical Evaluation

This DQO was not established at the time of sampling. As a result, it is only partially addressed. The full suite of fingerprint analytes required for historical DQOs (Simpson and McCain 1995) was analyzed in part for safety screening requirements and also for opportunistic analyses. Composites were not taken as required for this DQO.

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6.0 CONCLUSIONS AND RECOMMENDATIONS

The waste in tank 241-B-104 has been sampled and analyzed for the purposes of safety screening in accordance with the requirements listed in the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), and *Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994). The tank was sampled in June 1995 using the push-mode core sampling method. The safety screening DQO required analyses for percent water, energetics, total alpha activity, and flammable gas. Analyses for lithium and bromide were also performed in order to detect any contamination by the hydrostatic head fluid. In the process of measuring the bromide and lithium concentrations, the concentrations of several other anions and metals were determined (Kristofzski 1995). These analyses indicated that the tank contents were relatively homogeneous and did not consist of defined layers as predicted. Estimated tank inventories are based on historical density estimates. These data are unvalidated and should not be used to make decisions.

All analyses met the requirements of the safety screening DQO; all total alpha, DSC, percent water, and flammable gas results satisfied respective DQO criteria. Although historical DQOs apply to this tank (Simpson and McCain 1995), this DQO was not established at the time of sampling. Additional analyses are required to fully comply with historical requirements.

Hydrostatic head fluid marked with a lithium bromide tracer was used to obtain the core samples. The results of lithium and bromide analyses, performed to detect intrusion into the samples by the hydrostatic head fluid, were all less than the notification limits. The impact of the hydrostatic head fluid on weight percent water results was most likely minimal.

No heat load calculation was possible from the analytical data; however, an estimated value (not to be used to make decisions) of 0.0428 kW (146 Btu/hr) is listed in the HTCE (Brevick et al. 1994a), which is well below the 11.7-kW (39,900-Btu/hr) limit separating high- and low-heat load tanks (Bergmann 1991).

Sampling showed that the concentrations of flammable gases in the tank headspace was 0%. This meets the requirement for flammable gases to be less than 25% of the LFL.

ICP and IC analyses suggest that tank contents are relatively homogeneous with depth. This finding conflicts with current historical tank content estimates (Brevick et al. 1994a). Additional statistical analyses are necessary to support this finding.

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APPENDIX A

ANALYTICAL RESULTS

SINGLE-SHELL TANK 241-B-104

A.1 INTRODUCTION

Appendix A presents the analytical results of the June 1995 sampling and analysis event, including the weight percent water, total alpha activity, and the concentrations of selected anions and cations.

The data table for each analyte lists the laboratory sample identification, a description of where the sample was obtained (core/segment/segment portion), an original and duplicate result for each sample, a sample mean, a mean for the tank in which all cores, core segments, and segment portions are weighted equally, a relative standard deviation of the mean, and a projected tank inventory for the particular analyte using the weighted mean and the appropriate conversion factors. The projected tank inventory column is not applicable for percent water data. The data are listed in standard notation for values greater than 0.001 and less than 100,000. Values outside these limits are listed in scientific notation.

A.2 ANALYTE TABLE DESCRIPTION

Column one, Sample Number, lists the laboratory sample for which the analyte was measured. Sampling rationale, locations, and a description of the June 1995 sampling event are discussed in Section 3.0.

Column two describes the core and segment from which each sample was derived. The first number listed is the core number, which is followed by a colon and the segment number.

Column three contains the name of the segment portion from which the sample was taken. This can be the entire segment, denoted 'whole' (all solids); drainable liquid; or the segment portion designated by 'upper ½' or 'lower ½.'

Columns four and five, Result and Duplicate, are self-explanatory.

Column six, Mean, is the average of the result and duplicate values. All values, including those below the detection level (denoted by a 'less than' symbol, <), were averaged. If both sample values were non-detected, the mean is expressed as a non-detected value. If one or both values were above the detection limit, the mean is expressed as a detected value.

Column seven, Overall Mean, is a weighted mean of all segment portion means, all segment means, and both core means. This resulted in a calculated mean that was as spatially balanced as possible. As discussed in the previous paragraph, means were assigned a 'detect' or 'non-detect' status depending upon the relative number of non-detected values in the data set. Means for data sets having greater than 50 percent non-detected values were assigned a status of 'non-detect'.

Column eight, RSD (mean), or relative standard deviation of the mean, is the standard deviation of the mean divided by the mean, times one hundred. The RSDs were calculated using analysis of variance techniques only for those analytes in which at least half of the individual results were above the detection limit.

Column nine, Projected Inventory, is the product of the overall mean concentration of the analyte, the estimated density of 1.38 g/mL, the volume of the waste in the tank (1,400 kL), and the appropriate conversion factors. The following equations express the projected inventory of the selected anions, and of the total alpha activity.

$$kg = (Result\ in\ \frac{\mu g}{g})\ (\frac{1 kg}{1E{+}09\ \mu g})\ (\frac{1.38\ g}{mL})\ (\frac{1{,}000\ mL}{L})\ (1.40E{+}06\ L)$$

$$Ci = (Result\ in\ \frac{\mu Ci}{g})\ (\frac{Ci}{1E{+}06\ \mu Ci})\ (\frac{1.38\ g}{mL})\ (\frac{1{,}000\ mL}{L})\ (1.40E{+}06\ L).$$

The four quality control (QC) parameters assessed on the tank 241-B-104 samples were standards, spikes, duplicates, and blanks. The QC results were summarized in Section 5.1.2. More specific information is provided with each of the following appendix tables. Sample and duplicate pairs in which any of the QC parameters were outside their specified limits are footnoted in column 6. Footnotes are defined as follows.

[1] indicates that the standard recovery was below the QC limit.

[2] indicates that the standard recovery was above the QC limit.

[3] indicates that the spike recovery was below the QC limit.

[4] indicates that the spike recovery was above the QC limit.

[5] indicates that the RPD was outside the QC limits.

The QC criteria specified in the sampling and analysis plan (Jo 1995b, Appendix A) were:

90 to 100 percent recovery for standards, 75 to 125 percent recovery for matrix spikes, $\pm$20 percent for RPDs, and blanks $\leq$ 5 percent of the analyte concentration.

QC information was not available for the ICP opportunistic analyses.

Table A-1. Tank 241-B-104 Analytical Results: Thermogravimetric Analysis (TGA). (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			%	%	%	%	%	kg
1049	88:1	Whole	61.19	42.34	51.77[5]	46.9	2.0	n/a
1054	88:2	Upper ½	40.90	44.75	42.83			
1055		Lower ½	49.93	49.14	49.53			
1062	88:3	Upper ½	44.18	40.79	42.48			
1061		Lower ½	46.69	47.98	47.33			
1068	88:4	Upper ½	42.50	28.08	35.29[5]			
1067		Lower ½	46.69	44.72	45.70			
1076	88:5	Upper ½	49.84	44.24	47.04			
1075		Lower ½	48.98	48.39	48.69			
1092	88:6	Upper ½	45.15	46.11	45.63			
1091		Lower ½	46.15	46.26	46.20			
1100	88:7	Upper ½	46.20	47.65	46.92			
1099		Lower ½	44.64	44.37	44.50			
1108	89:1	Upper ½	46.64	45.46	46.05			
1107		Lower ½	47.84	47.14	47.49			
1114	89:2	Upper ½	48.32	48.13	48.23			
1113		Lower ½	47.16	47.09	47.12			
1131	89:3	Upper ½	47.63	47.55	47.59			
1130		Lower ½	47.93	46.20	47.06			
1137	89:4	Upper ½	48.17	48.24	48.20			
1136		Lower ½	46.97	47.23	47.10			

Table A-1. Tank 241-B-104 Analytical Results: Thermogravimetric Analysis (TGA). (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			%	%	%	%	%	kg
1143	89:5	Upper ½	49.80	49.08	49.44	Cont'd	Cont'd	Cont'd
1142		Lower ½	47.12	47.40	47.26			
1149	89:6	Upper ½	46.98	47.07	47.02			
1148		Lower ½	50.27	48.02	49.15			
1155	89:7	Upper ½	46.62	46.56	46.59			
1154		Lower ½	47.88	47.82	47.85			
1051	88:1	Drainable liquid	51.68	49.90	50.79	52.1	2.5	n/a
1104	89:1	Drainable liquid	53.69	53.11	53.40			

Table A-2. Tank 241-B-104 Analytical Results: Total Alpha. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µCi/g	µCi/g	µCi/g	µCi/g	%	Ci
1050	88:1	Whole	0.0390	0.0389	0.0389	0.0440	22.3	85
1057	88:2	Upper ½	0.0470	0.0442	0.0456			
1056		Lower ½	0.0451	0.0550	0.0500			
1064	88:3	Upper ½	0.0368	0.0838	0.0603[5]			
1063		Lower ½	0.0521	0.00268	0.0274[5]			
1072	88:4	Upper ½	0.0429	0.0490	0.0460			
1071		Lower ½	0.0534	0.0436	0.0485[5]			
1079	88:5	Upper ½	0.0516	0.0590	0.0553			
1077		Lower ½	0.0533	0.0568	0.0551			
1094	88:6	Upper ½	0.0489	0.0435	0.0462			
1093		Lower ½	0.0372	0.0430	0.0401			
1102	88:7	Upper ½	0.0434	0.0476	0.0455[2]			
1101		Lower ½	< 0.319	< 0.309	< 0.314[2]			
1110	89:1	Upper ½	0.0388	0.0425	0.0407			
1109		Lower ½	0.0514	0.0505	0.0510			
1116	89:2	Upper ½	0.0409	0.0496	0.0452			
1115		Lower ½	0.0518	0.0509	0.0513			
1133	89:3	Upper ½	0.0490	0.0484	0.0487			
1132		Lower ½	0.0310	0.0493	0.0401[3,5]			
1139	89:4	Upper ½	0.0359	0.0420	0.0389[3]			
1138		Lower ½	0.0331	0.0377	0.0354			

Table A-2. Tank 241-B-104 Analytical Results: Total Alpha. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µCi/g	µCi/g	µCi/g	µCi/g	%	Ci
1145	89:5	Upper ½	0.0439	0.0401	0.0420	Cont'd	Cont'd	Cont'd
1144		Lower ½	0.0382	0.0385	0.0383			
1151	89:6	Upper ½	0.0388	0.0357	0.0373[3]			
1150		Lower ½	0.0382	0.0543	0.0462[3,5]			
1157	89:7	Upper ½	0.0406	0.0390	0.0398			
1156		Lower ½	0.0462	0.0434	0.0448			

Table A-3. Tank 241-B-104 Analytical Data: Chloride. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			μg/g	μg/g	μg/g	μg/g	%	kg
1819	88:1	Whole	2,230	1,840	2,040[3]	2,110	4.2	4,080
1823	88:2	Upper ½	1,610	1,570	1,590			
1822		Lower ½	1,630	1,590	1,610			
1825	88:3	Upper ½	2,260	2,020	2,140[3]			
1824		Lower ½	1,550	1,880	1,720			
1827	88:4	Upper ½	3,420	3,410	3,420			
1826		Lower ½	2,080	2,110	2,100			
1829	88:5	Upper ½	1,920	1,750	1,840			
1828		Lower ½	2,100	2,160	2,130			
1831	88:6	Upper ½	1,770	1,860	1,820			
1830		Lower ½	2,040	1,810	1,920			
1833	88:7	Upper ½	2,200	2,140	2,170			
1832		Lower ½	1,800	1,720	1,760			
1848	89:1	Upper ½	1,890	1,870	1,880			
1847		Lower ½	1,820	2,950	2,380[5]			
1850	89:2	Upper ½	1,700	1,730	1,720			
1849		Lower ½	1,900	1,980	1,940			
1852	89:3	Upper ½	2,920	3,010	2,960			
1851		Lower ½	1,850	2,010	1,930			
1854	89:4	Upper ½	2,220	2,140	2,180			
1853		Lower ½	2,130	2,290	2,210			

Table A-3. Tank 241-B-104 Analytical Data: Chloride. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1856	89:5	Upper ½	2,280	2,140	2,210	Cont'd	Cont'd	Cont'd
1855		Lower ½	2,870	2,200	2,540[5]			
1858	89:6	Upper ½	2,310	2,240	2,280			
1857		Lower ½	2,090	2,120	2,100			
1860	89:7	Upper ½	2,200	2,170	2,180			
1859		Lower ½	2,210	2,250	2,230			

Table A-4. Tank 241-B-104 Analytical Data: Fluoride. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1819	88:1	Whole	3,830	3,710	3,770[3]	3,460	20.6	6,680
1823	88:2	Upper ½	4,660	3,560	4,110[5]			
1822		Lower ½	3,210	4,010	3,610[5]			
1825	88:3	Upper ½	3,500	3,570	3,540			
1824		Lower ½	3,090	3,580	3,340			
1827	88:4	Upper ½	8,960	8,780	8,870[3]			
1826		Lower ½	3,440	3,360	3400			
1829	88:5	Upper ½	3,210	2,970	3,090			
1828		Lower ½	4,740	5,460	5,100			
1831	88:6	Upper ½	4,600	4,630	4,620			
1830		Lower ½	3,370	2,980	3,180			
1833	88:7	Upper ½	1,190	1,470	1,330[5]			
1832		Lower ½	6,580	6,430	6,500			
1848	89:1	Upper ½	3,780	2,470	3,120[5]			
1847		Lower ½	3,320	2,890	3,100			
1850	89:2	Upper ½	3,300	2,620	2,960[5]			
1849		Lower ½	3,950	2,720	3,340[5]			
1852	89:3	Upper ½	2,810	2,960	2,880			
1851		Lower ½	2,470	2,720	2,600			
1854	89:4	Upper ½	2,640	2,270	2,460			
1853		Lower ½	2,390	1,730	2,060[5]			

Table A-4. Tank 241-B-104 Analytical Data: Fluoride. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1856	89:5	Upper ½	805.0	1,940	1,370[5]	Cont'd	Cont'd	Cont'd
1855		Lower ½	3,660	1,130	2,400[5]			
1858	89:6	Upper ½	2,880	3,150	3,020			
1857		Lower ½	2,880	2,690	2,780			
1860	89:7	Upper ½	2,960	3,130	3,040			
1859		Lower ½	3,590	3,540	3,560			

Table A-5. Tank 241-B-104 Analytical Data: Nitrite. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1819	88:1	Whole	1,680	1,650	1,660	2,450	8.7	4,730
1823	88:2	Upper ½	1,690	1,660	1,680			
1822		Lower ½	1,590	1,880	1,740			
1825	88:3	Upper ½	2,020	2,090	2,060			
1824		Lower ½	1,830	2,110	1,970			
1827	88:4	Upper ½	3,510	3,500	3,500			
1826		Lower ½	2,210	2,220	2,220			
1829	88:5	Upper ½	2,090	1,880	1,980			
1828		Lower ½	2,480	2,570	2,520			
1831	88:6	Upper ½	< 5,400	< 5,400	< 5,400			
1830		Lower ½	2,390	2,090	2,240			
1833	88:7	Upper ½	2,610	2,530	2,570			
1832		Lower ½	< 5,430	< 5,430	< 5,430			
1848	89:1	Upper ½	< 2,130	< 2,130	< 2,130			
1847		Lower ½	1,830	1,470	1,650[5]			
1850	89:2	Upper ½	1,720	1,720	1,720			
1849		Lower ½	1,890	1,950	1,920			
1852	89:3	Upper ½	2,740	2,770	2,760			
1851		Lower ½	1,830	1,990	1,910			
1854	89:4	Upper ½	2,090	2,050	2,070			
1853		Lower ½	2,020	2,140	2,080			

Table A-5. Tank 241-B-104 Analytical Data: Nitrite. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1856	89:5	Upper ½	2,180	2,030	2,100	Cont'd	Cont'd	Cont'd
1855		Lower ½	2,240	2,190	2,220			
1858	89:6	Upper ½	2,110	2,090	2,100			
1857		Lower ½	2,000	2,030	2,020			
1860	89:7	Upper ½	< 5,190	< 5,190	< 5,190			
1859		Lower ½	2,080	2,110	2,100			

Table A-6. Tank 241-B-104 Analytical Data: Nitrate. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1819	88:1	Whole	3.05E+05	3.25E+05	3.15E+05	2.90E+05	4.8	5.60E+05
1823	88:2	Upper ½	2.85E+05	3.00E+05	2.92E+05			
1822		Lower ½	4.30E+05	3.80E+05	4.05E+05			
1825	88:3	Upper ½	2.62E+05	2.64E+05	2.63E+05			
1824		Lower ½	2.68E+05	2.90E+05	2.79E+05			
1827	88:4	Upper ½	4.51E+05	5.02E+05	4.76E+05			
1826		Lower ½	2.65E+05	2.71E+05	2.68E+05			
1829	88:5	Upper ½	2.70E+05	2.79E+05	2.74E+05			
1828		Lower ½	2.72E+05	2.80E+05	2.76E+05			
1831	88:6	Upper ½	2.83E+05	2.86E+05	2.84E+05			
1830		Lower ½	2.70E+05	2.72E+05	2.71E+05			
1833	88:7	Upper ½	2.74E+05	2.67E+05	2.70E+05			
1832		Lower ½	2.69E+05	2.70E+05	2.70E+05			
1848	89:1	Upper ½	2.83E+05	2.94E+05	2.88E+05			
1847		Lower ½	2.57E+05	2.66E+05	2.62E+05			
1850	89:2	Upper ½	2.71E+05	2.81E+05	2.76E+05			
1849		Lower ½	2.81E+05	2.92E+05	2.86E+05			
1852	89:3	Upper ½	2.41E+05	2.51E+05	2.46E+05			
1851		Lower ½	2.88E+05	2.84E+05	2.86E+05			
1854	89:4	Upper ½	2.81E+05	2.85E+05	2.83E+05			
1853		Lower ½	2.66E+05	2.81E+05	2.74E+05			

Table A-6. Tank 241-B-104 Analytical Data: Nitrate. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1856	89:5	Upper ½	3.07E+05	2.74E+05	2.90E+05	Cont'd	Cont'd	Cont'd
1855		Lower ½	3.11E+05	3.12E+05	3.12E+05			
1858	89:6	Upper ½	2.77E+05	2.62E+05	2.70E+05			
1857		Lower ½	2.71E+05	2.75E+05	2.73E+05			
1860	89:7	Upper ½	2.53E+05	2.60E+05	2.56E+05			
1859		Lower ½	2.57E+05	2.64E+05	2.60E+05			

Table A-7. Tank 241-B-104 Analytical Data: Oxalate. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1819	88:1	Whole	< 787	< 787	< 787	< 1,470	n/a	< 2,840
1823	88:2	Upper ½	< 527	< 527	< 527			
1822		Lower ½	< 1,040	< 1,040	< 1,040			
1825	88:3	Upper ½	< 828	< 828	< 828			
1824		Lower ½	< 1,040	< 1,040	< 1,040			
1827	88:4	Upper ½	< 800	< 800	< 800			
1826		Lower ½	< 794	< 794	< 794			
1829	88:5	Upper ½	< 977	< 977	< 977			
1828		Lower ½	< 1,490	< 1,490	< 1,490			
1831	88:6	Upper ½	< 4,890	< 4,890	< 4,890			
1830		Lower ½	< 1,030	< 1,030	< 1,030			
1833	88:7	Upper ½	< 947	< 947	< 947			
1832		Lower ½	< 4,930	< 4,930	< 4,930			
1848	89:1	Upper ½	< 1,930	< 1,930	< 1,930			
1847		Lower ½	< 908	< 908	< 908			
1850	89:2	Upper ½	< 999	< 999	< 999			
1849		Lower ½	< 1,250	< 1,250	< 1,250			
1852	89:3	Upper ½	< 1,040	< 1,040	< 1,040			
1851		Lower ½	< 1,010	< 1,010	< 1,010			
1854	89:4	Upper ½	< 1,350	< 1,350	< 1,350			
1853		Lower ½	< 1,070	< 1,070	< 1,070			

Table A-7. Tank 241-B-104 Analytical Data: Oxalate. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1856	89:5	Upper ½	< 841	< 841	< 841	Cont'd	Cont'd	Cont'd
1855		Lower ½	< 2,150	< 2,140	< 2,150			
1858	89:6	Upper ½	< 1,080	< 1,080	< 1,080			
1857		Lower ½	< 731	< 731	< 731			
1860	89:7	Upper ½	< 4,920	< 4,920	< 4,920			
1859		Lower ½	< 1,050	< 1,050	< 1,050			

Table A-8. Tank 241-B-104 Analytical Data: Phosphate. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1819	88:1	Whole	19,900	19,100	19,500	23,300	3.8	45,000
1823	88:2	Upper ½	21,200	20,100	20,600			
1822		Lower ½	19,000	22,700	20,800			
1825	88:3	Upper ½	21,500	22,600	22,000			
1824		Lower ½	21,600	23,100	22,400			
1827	88:4	Upper ½	40,100	47,500	43,800			
1826		Lower ½	24,000	23,300	23,600			
1829	88:5	Upper ½	21,400	19,000	20,200			
1828		Lower ½	25,800	27,000	26,400			
1831	88:6	Upper ½	22,500	22,200	22,400			
1830		Lower ½	24,000	21,300	22,600			
1833	88:7	Upper ½	23,100	23,200	23,200			
1832		Lower ½	21,800	21,700	21,800			
1848	89:1	Upper ½	22,000	20,200	21,100			
1847		Lower ½	24,500	25,000	24,800			
1850	89:2	Upper ½	22,200	21,300	21,800			
1849		Lower ½	22,900	21,600	22,200			
1852	89:3	Upper ½	30,100	30,800	30,400			
1851		Lower ½	20,600	22,300	21,400			
1854	89:4	Upper ½	22,800	21,800	22,300			
1853		Lower ½	22,100	21,900	22,000			

Table A-8. Tank 241-B-104 Analytical Data: Phosphate. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1856	89:5	Upper ½	21,200	23,300	22,200	Cont'd	Cont'd	Cont'd
1855		Lower ½	26,500	20,000	23,200[5]			
1858	89:6	Upper ½	23,100	22,200	22,600			
1857		Lower ½	23,200	23,200	23,200			
1860	89:7	Upper ½	21,000	22,200	21,600			
1859		Lower ½	24,200	23,400	23,800			

Table A-9. Tank 241-B-104 Analytical Data: Sulfate. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1819	88:1	Whole	19,400	18,700	19,000	21,400	9.1	41,300
1823	88:2	Upper ½	19,400	18,900	19,200			
1822		Lower ½	33,700	27,000	30,400[5]			
1825	88:3	Upper ½	20,800	22,200	21,500			
1824		Lower ½	20,000	21,500	20,800			
1827	88:4	Upper ½	42,100	39,100	40,600			
1826		Lower ½	22,800	24,500	23,600			
1829	88:5	Upper ½	20,100	17,300	18,700			
1828		Lower ½	26,300	25,900	26,100			
1831	88:6	Upper ½	22,300	22,400	22,400			
1830		Lower ½	21,000	18,600	19,800			
1833	88:7	Upper ½	20,600	20,000	20,300			
1832		Lower ½	23,400	22,900	23,200			
1848	89:1	Upper ½	20,700	17,900	19,300			
1847		Lower ½	16,900	17,500	17,200			
1850	89:2	Upper ½	16,700	17,200	17,000			
1849		Lower ½	18,400	18,900	18,600			
1852	89:3	Upper ½	27,500	23,900	25,700			
1851		Lower ½	17,800	19,400	18,600			
1854	89:4	Upper ½	20,200	19,900	20,000			
1853		Lower ½	18,800	19,600	19,200			

Table A-9. Tank 241-B-104 Analytical Data: Sulfate. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			μg/g	μg/g	μg/g	μg/g	%	kg
1856	89:5	Upper ½	20,900	20,000	20,400	Cont'd	Cont'd	Cont'd
1855		Lower ½	21,700	19,800	20,800			
1858	89:6	Upper ½	19,500	19,300	19,400			
1857		Lower ½	19,800	20,200	20,000			
1860	89:7	Upper ½	18,500	18,800	18,600			
1859		Lower ½	19,300	19,700	19,500			

Table A-10. Tank 241-B-104 Analytical Data: Aluminum. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1050	88:1	Whole	2,933	3,138	2,327	1,843	39	3,560
1057	88:2	Upper ½	3,101	3,070				
1056		Lower ½	2,714	2,986				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	1,760	1,970				
1071		Lower ½	2,093	1,920				
1079	88:5	Upper ½	1,478	1,788				
1077		Lower ½	2,137	2,268				
1094	88:6	Upper ½	2,274	2,093				
1093		Lower ½	1,776	1,786				
1102	88:7	Upper ½	933	682				
1101		Lower ½	3,821	3,066				
1110	89:1	Upper ½	1,323	1,376	1,429			
1109		Lower ½	1,280	1,309				
1116	89:2	Upper ½	1,495	1,548				
1115		Lower ½	2,065	2,115				
1133	89:3	Upper ½	1,377	1,386				
1132		Lower ½	1,330	1,451				

Table A-10. Tank 241-B-104 Analytical Data: Aluminum. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1139	89:4	Upper ½	1,106	1,249	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	977	1,207				
1145	89:5	Upper ½	973	1,059				
1144		Lower ½	1,472	1,316				
1151	89:6	Upper ½	1,400	1,691				
1150		Lower ½	1,941	2,018				
1157	89:7	Upper ½	1,795	1,480				
1156		Lower ½	1,306	1,310				

Table A-11. Tank 241-B-104 Analytical Data: Bismuth. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1050	88:1	Whole	12,416	13,782	12,362	11,425	24	22,050
1057	88:2	Upper ½	16,380	15,618				
1056		Lower ½	14,308	16,104				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	11,150	11,950				
1071		Lower ½	14,470	12,730				
1079	88:5	Upper ½	9,336	11,278				
1077		Lower ½	13,080	13,550				
1094	88:6	Upper ½	10,800	9,530				
1093		Lower ½	2,113	5,844				
1102	88:7	Upper ½	13,940	11,860				
1101		Lower ½	16,680	13,560				
1110	89:1	Upper ½	7,913	8,620	10,622			
1109		Lower ½	10,364	10,799				
1116	89:2	Upper ½	7,630	8,622				
1115		Lower ½	9,612	10,433				
1133	89:3	Upper ½	10,048	7,154				
1132		Lower ½	9,278	10,858				

Table A-11. Tank 241-B-104 Analytical Data: Bismuth. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1139	89:4	Upper ½	10,272	11,065	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	8,578	10,395				
1145	89:5	Upper ½	12,973	13,114				
1144		Lower ½	13,010	11,788				
1151	89:6	Upper ½	14,080	14,420				
1150		Lower ½	11,320	10,480				
1157	89:7	Upper ½	11,850	10,990				
1156		Lower ½	10,470	11,270				

Table A-12. Tank 241-B-104 Analytical Data: Calcium. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1050	88:1	Whole	371	294	355	328	31	630
1057	88:2	Upper ½	460	353				
1056		Lower ½	302	284				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	237	214				
1071		Lower ½	412	279				
1079	88:5	Upper ½	462	403				
1077		Lower ½	197	197				
1094	88:6	Upper ½	378	394				
1093		Lower ½	509	511				
1102	88:7	Upper ½	410	309				
1101		Lower ½	423	453				
1110	89:1	Upper ½	388	361	306			
1109		Lower ½	231	248				
1116	89:2	Upper ½	272	287				
1115		Lower ½	272	276				
1133	89:3	Upper ½	268	230				
1132		Lower ½	249	250				

Table A-12. Tank 241-B-104 Analytical Data: Calcium. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1139	89:4	Upper ½	185	174	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	134	158				
1145	89:5	Upper ½	354	391				
1144		Lower ½	444	281				
1151	89:6	Upper ½	284	258				
1150		Lower ½	350	355				
1157	89:7	Upper ½	357	399				
1156		Lower ½	647	458				

Table A-13. Tank 241-B-104 Analytical Data: Chromium. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1050	88:1	Whole	467	534	542	513	16	990
1057	88:2	Upper ½	460	602				
1056		Lower ½	558	616				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	438	475				
1071		Lower ½	616	539				
1079	88:5	Upper ½378	378	512				
1077		Lower ½	525	542				
1094	88:6	Upper ½	470	463				
1093		Lower ½	604	615				
1102	88:7	Upper ½	610	528				
1101		Lower ½	770	679				
1110	89:1	Upper ½	409	415	488			
1109		Lower ½	417	427				
1116	89:2	Upper ½	462	474				
1115		Lower ½	502	521				
1133	89:3	Upper ½	491	501				
1132		Lower ½	492	514				

Table A-13. Tank 241-B-104 Analytical Data: Chromium. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1139	89:4	Upper ½	397	420	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	327	405				
1145	89:5	Upper ½	556	534				
1144		Lower ½	529	511				
1151	89:6	Upper ½	484	492				
1150		Lower ½	637	678				
1157	89:7	Upper ½	494	487				
1156		Lower ½	553	544				

Table A-14. Tank 241-B-104 Analytical Data: Iron. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1050	88:1	Whole	10,417	11,317	11,085	10,544	13	20830
1057	88:2	Upper ½	11,841	11,805				
1056		Lower ½	10,982	12,375				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	9,585	10,070				
1071		Lower ½	13,620	12,230				
1079	88:5	Upper ½	8,149	10,018				
1077		Lower ½	10,520	10,970				
1094	88:6	Upper ½	8,470	9,050				
1093		Lower ½	11,782	13,017				
1102	88:7	Upper ½	12,720	11,140				
1101		Lower ½	12,930	11,300				
1110	89:1	Upper ½	10,576	10,820	10,544			
1109		Lower ½	9,947	10,284				
1116	89:2	Upper ½	10,313	10,699				
1115		Lower ½	10,406	11,019				
1133	89:3	Upper ½	10,554	9,983				
1132		Lower ½	10,767	11,474				

Table A-14. Tank 241-B-104 Analytical Data: Iron. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1139	89:4	Upper ½	8,802	9,025	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	6,801	7,739				
1145	89:5	Upper ½	12,004	12,044				
1144		Lower ½	11,167	10,338				
1151	89:6	Upper ½	10,180	99,943				
1150		Lower ½	12,850	13,040				
1157	89:7	Upper ½	11,050	10,970				
1156		Lower ½	11,110	11,320				

Table A-15. Tank 241-B-104 Analytical Data: Sodium. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1050	88:1	Whole	118,363	127,897	118,096	117,149	9	226,100
1057	88:2	Upper ½	132,641	128,123				
1056		Lower ½	112,236	125,707				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	100,100	116,800				
1071		Lower ½	115,500	117,700				
1079	88:5	Upper ½	125,056	125,855				
1077		Lower ½	123,700	121,600				
1094	88:6	Upper ½	111,100	105,900				
1093		Lower ½	120,345	119,713				
1102	88:7	Upper ½	119,900	104,200				
1101		Lower ½	112,600	103,000				
1110	89:1	Upper ½	118,848	120,475	116,338			
1109		Lower ½	118,030	118,569				
1116	89:2	Upper ½	113,544	114,048				
1115		Lower ½	120,438	121,231				
1133	89:3	Upper ½	119,084	120,428				
1132		Lower ½	119,496	119,033				

Table A-15. Tank 241-B-104 Analytical Data: Sodium. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1139	89:4	Upper ½	100,722	94,647	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	860,32	97,992				
1145	89:5	Upper ½	120,144	120,024				
1144		Lower ½	125,218	124,762				
1151	89:6	Upper ½	112,000	106,300				
1150		Lower ½	128,300	124,200				
1157	89:7	Upper ½	138,200	134,200				
1156		Lower ½	112,700	108,800				

Table A-16. Tank 241-B-104 Analytical Data: Phosphorus. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1050	88:1	Whole	14,936	16,790	17,652	17,043	15	32,890
1057	88:2	Upper ½	17,706	18,241				
1056		Lower ½	16,364	18,575				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	15,080	18,140				
1071		Lower ½	21,620	19,510				
1079	88:5	Upper ½	14,021	16,309				
1077		Lower ½	18,180	18,570				
1094	88:6	Upper ½	14,900	14,810				
1093		Lower ½	17,698	17,703				
1102	88:7	Upper ½	18,720	16,320				
1101		Lower ½	24,810	22,930				
1110	89:1	Upper ½	19,139	18,615	16,521			
1109		Lower ½	17,398	17,088				
1116	89:2	Upper ½	18,811	18,673				
1115		Lower ½	17,418	18,684				
1133	89:3	Upper ½	16,204	16,475				
1132		Lower ½	16,033	16,102				

Table A-16. Tank 241-B-104 Analytical Data: Phosphorus. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1139	89:4	Upper ½	12,147	11,489	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	10,145	1,229				
1145	89:5	Upper ½	17,181	16,064				
1144		Lower ½	15,480	15,217				
1151	89:6	Upper ½	15,700	15,910				
1150		Lower ½	20,130	20,440				
1157	89:7	Upper ½	16,530	17,660				
1156		Lower ½	17,690	17,890				

Table A-17. Tank 241-B-104 Analytical Data: Sulfur. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			μg/g	μg/g	μg/g	μg/g	%	kg
1050	88:1	Whole	6,154	6,769	7,577	7,284	12	14,060
1057	88:2	Upper ½	7,113	7,490				
1056		Lower ½	6,808	7,612				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	7,486	8,484				
1071		Lower ½	8,101	8,270				
1079	88:5	Upper ½	7,676	8,024				
1077		Lower ½	8,420	8,684				
1094	88:6	Upper ½	7,039	6,934				
1093		Lower ½	7,311	7,356				
1102	88:7	Upper ½	7,791	6,740				
1101		Lower ½	9,481	9,183				
1110	89:1	Upper ½	6,803	6,807	7,034			
1109		Lower ½	7,017	6,933				
1116	89:2	Upper ½	6,837	6,870				
1115		Lower ½	6,845	7,199				
1133	89:3	Upper ½	7,015	7,123				
1132		Lower ½	7,016	7,007				

Table A-17. Tank 241-B-104 Analytical Data: Sulfur. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1139	89:4	Upper ½	5,641	5,315	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	4,988	5,891				
1145	89:5	Upper ½	7,277	7,035				
1144		Lower ½	7,043	7,170				
1151	89:6	Upper ½	6,878	6,832				
1150		Lower ½	8,367	8,573				
1157	89:7	Upper ½	7,643	7,720				
1156		Lower ½	8,422	8,676				

Table A-18. Tank 241-B-104 Analytical Data: Silicon. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			μg/g	μg/g	μg/g	μg/g	%	kg
1050	88:1	Whole	5,084	5,567	6,227	5,697	20	11,000
1057	88:2	Upper ½	7,273	7,124				
1056		Lower ½	6,686	7,416				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	4,498	5,026				
1071		Lower ½	6,584	6,026				
1079	88:5	Upper ½	6,143	6,547				
1077		Lower ½	5,262	5,356				
1094	88:6	Upper ½	6,861	4,713				
1093		Lower ½	8,744	7,162				
1102	88:7	Upper ½	7,436	6,286				
1101		Lower ½	6,960	6,038				
1110	89:1	Upper ½	4,516	4,579	5,243			
1109		Lower ½	4,574	4,760				
1116	89:2	Upper ½	4,505	4,612				
1115		Lower ½	4,779	4,881				
1133	89:3	Upper ½	5,194	5,419				
1132		Lower ½	4,865	5,311				

Table A-18. Tank 241-B-104 Analytical Data: Silicon. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1139	89:4	Upper ½	3,709	3,448	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	3,169	4,419				
1145	89:5	Upper ½	6,282	6,375				
1144		Lower ½	6,042	5,492				
1151	89:6	Upper ½	5,276	5,789				
1150		Lower ½	7,137	7,271				
1157	89:7	Upper ½	6,084	5,297				
1156		Lower ½	6,191	6,184				

Table A-19. Tank 241-B-104 Analytical Data: Uranium. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g	Overall Mean µg/g	RSD (Mean) %	Projected Inventory kg
1050	88:1	Whole	<1,781	<1,888	<1,953	<1,920	n/a	<3,700
1057	88:2	Upper ½	<1,810	<1,781				
1056		Lower ½	<1,757	<1,776				
1064	88:3	Upper ½	n/a	n/a				
1063		Lower ½	n/a	n/a				
1072	88:4	Upper ½	<1,950	<1,950				
1071		Lower ½	2,109	1,890				
1079	88:5	Upper ½	<2,072	<2,061				
1077		Lower ½	<2,200	<2,210				
1094	88:6	Upper ½	<2,074	<2,050				
1093		Lower ½	<2,083	<2,017				
1102	88:7	Upper ½	<1,998	<1,957				
1101		Lower ½	<1,930	<1,873				
1110	89:1	Upper ½	3,885	3,947	<1,888			
1109		Lower ½	2,296	2,479				
1116	89:2	Upper ½	2,324	2,391				
1115		Lower ½	1,774	2,029				
1133	89:3	Upper ½	1,360	1,253				
1132		Lower ½	1,470	1,698				

Table A-19. Tank 241-B-104 Analytical Data: Uranium. (2 sheets)

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean	Overall Mean	RSD (Mean)	Projected Inventory
			µg/g	µg/g	µg/g	µg/g	%	kg
1139	89:4	Upper ½	1,097	1,074	Cont'd	Cont'd	Cont'd	Cont'd
1138		Lower ½	818	906				
1145	89:5	Upper ½	<1,784	<1,779				
1144		Lower ½	<1,740	<1,771				
1151	89:6	Upper ½	<1,727	<1,742				
1150		Lower ½	<1,893	<1,908				
1157	89:7	Upper ½	<1,992	<1,950				
1156		Lower ½	<1,892	<1,892				

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APPENDIX B

RESULTS OF HYDROSTATIC HEAD FLUID CONTAMINATION CHECK

SINGLE-SHELL TANK 241-B-104

B.1 INTRODUCTION

Appendix B presents the results of the hydrostatic head fluid check for the June 1995 sampling and analysis event. Lithium and bromide were measured to detect any contamination of the waste samples by the hydrostatic head fluid.

The data table for each analyte lists laboratory sample identification, a description of where the sample was obtained (core/segment/segment portion), an original and duplicate result for each sample, and a sample mean.

B.2 ANALYTE TABLE DESCRIPTION

Column one, Sample Number, lists the laboratory sample for which the analyte was measured. Sampling rationale, locations, and a description of the June 1995 sampling event are discussed in Section 3.0.

Column two describes the core and segment from which each sample was derived. The first number listed is the core number, which is followed by a colon and the segment number.

Column three contains the name of the segment portion from which the sample was taken. This can be the entire segment, denoted 'whole' (all solids); drainable liquid; or the segment portion designated by 'upper ½' or 'lower ½.' Note that the bromide analysis was not performed on the drainable liquid samples.

Columns four and five, Result and Duplicate, are self-explanatory.

Column six, Mean, is the average of the result and duplicate values. All values, including those below the detection level (denoted by a 'less than' symbol, <), were averaged. If both sample values were non-detected, the mean is expressed as a non-detected value. If one or both values were above the detection limit, the mean is expressed as a detected value.

Table B-1. Tank 241-B-104 Hydrostatic Head Fluid Contamination Check: Lithium.

Sample Number	Core: Segment	Segment Portion	Result µg/g	Duplicate µg/g	Mean µg/g
1050	88:1	Whole	< 44.5315	< 47.2054	< 45.8684
1057	88:2	Upper ½	< 45.2489	< 44.5236	< 44.8862
1056		Lower ½	< 43.9213	< 44.3971	< 44.1592
1064	88:3	Upper ½	< 46.1200	< 45.4800	< 45.800
1063		Lower ½	< 46.2535	< 46.2364	< 46.2450
1072	88:4	Upper ½	13.37	14.86	14.11
1071		Lower ½	< 49.5400	< 49.6400	< 49.5900
1079	88:5	Upper ½	< 51.7920	< 51.5145	< 51.6532
1077		Lower ½	< 5.4990	< 5.5240	< 5.5115
1094	88:6	Upper ½	< 51.8560	< 51.2500	< 51.5530
1093		Lower ½	< 52.0833	< 50.4236	< 51.2534
1102	88:7	Upper ½	< 49.9500	< 48.9200	< 49.4350
1101		Lower ½	< 48.2400	< 46.8250	< 47.5325
1110	89:1	Upper ½	< 24.6865	< 24.5363	< 24.6114
1109		Lower ½	< 8.6881	< 8.7069	< 8.6975
1116	89:2	Upper ½	42.41	46.71	44.56
1115		Lower ½	23.15	24.22	23.69
1133	89:3	Upper ½	< 14.2045	< 14.1723	< 14.1884
1132		Lower ½	< 13.7431	< 13.7642	< 13.7536
1139	89:4	Upper ½	21.47	21.68	21.58
1138		Lower ½	5.710	6.559	6.135
1145	89:5	Upper ½	< 44.6030	< 44.4840	< 44.5435
1144		Lower ½	< 43.5010	< 44.2791	< 43.8900
1151	89:6	Upper ½	< 43.1700	< 43.5390	< 43.3545
1150		Lower ½	< 47.3310	< 47.6920	< 47.5115
1157	89:7	Upper ½	< 49.7900	< 48.7500	< 49.2700
1156		Lower ½	< 47.3000	50.50	48.90
1051	88:1	Drainable Liquid	< 4.0100	< 4.0100	< 4.0100
1104	89:1	Drainable Liquid	< 4.0100	< 4.0100	< 4.0100

Table B-2. Tank 241-B-104 Hydrostatic Head Fluid Contamination Check: Bromide.

Sample Number	Core: Segment	Segment Portion	Result	Duplicate	Mean
			µg/g	µg/g	µg/g
1819	88:1	Whole	< 238	< 238	< 238
1823	88:2	Upper ½	< 671	< 671	< 671
1822		Lower ½	< 1,250	< 1,250	< 1,250
1825	88:3	Upper ½	< 236	< 995	< 616
1824		Lower ½	< 1,320	< 1,320	< 1,320
1827	88:4	Upper ½	< 1,760	< 1,760	< 1,760
1826		Lower ½	< 954	< 954	< 954
1829	88:5	Upper ½	< 295	< 295	< 295
1828		Lower ½	< 1,900	< 1,900	< 1,900
1831	88:6	Upper ½	505.0	498.0	501.5
1830		Lower ½	358.0	355.0	356.5
1833	88:7	Upper ½	< 270	< 270	< 270
1832		Lower ½	< 310	< 310	< 310
1848	89:1	Upper ½	< 583	< 583	< 583
1847		Lower ½	< 259	< 259	< 259
1850	89:2	Upper ½	614.0	583.0	598.5
1849		Lower ½	506.0	513.0	509.5
1852	89:3	Upper ½	< 298	< 298	< 298
1851		Lower ½	< 306	< 306	< 306
1854	89:4	Upper ½	476.0	493.0	484.5
1853		Lower ½	< 306	< 306	< 306
1856	89:5	Upper ½	< 254	< 254	< 254
1855		Lower ½	657.0	660.0	658.5
1858	89:6	Upper ½	< 310	< 310	< 310
1857		Lower ½	< 221	< 221	< 221
1860	89:7	Upper ½	< 5,920	< 5,920	< 5,920
1859		Lower ½	< 299	< 299	< 299

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